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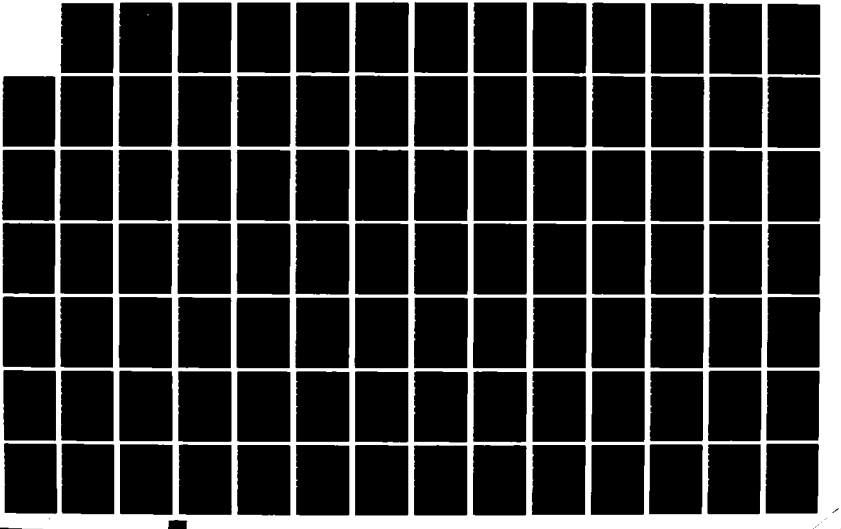

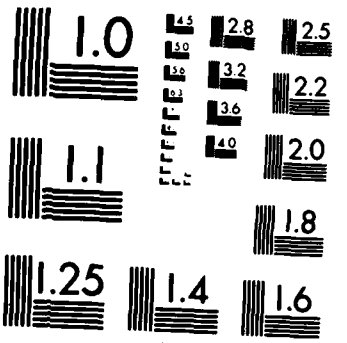

MINUTEMAN MISSILE FACILITIES MAINTENANCE TECHNICIAN (AFS 445X0G): ANALYSIS OF THE EFFECTS OF AFSC CONSOLIDATION ON PERSONNEL PROFICIENCY AND HARDWARE CONDITIONS

THESIS

Stephen C. Popp
Captain, USAF

Karen L. Selva
Captain, USAF

AFIT/GLM/LSM/84S-54

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GLM/LSM/84

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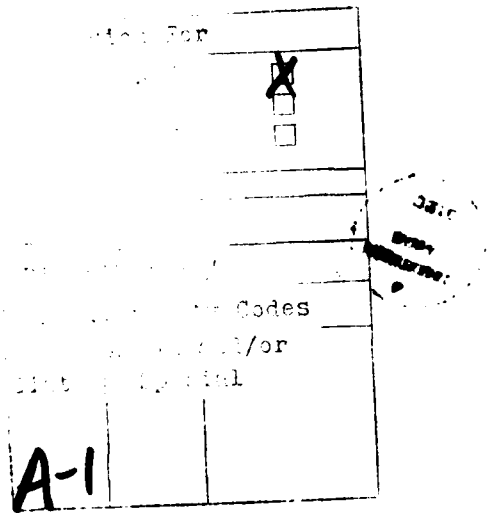

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THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

Stephen C. Popp, B.A., M.Ed.
Captain, USAF

Karen L. Selva, B.S.
Captain, USAF

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Preface

The purpose of this study was to determine if the technicians in the missile facilities career field have maintained an adequate level of proficiency since consolidation of several specialties into one generalized career field. As missile maintenance officers we are very concerned about the capability of the technicians performing maintenance on the ICBM fleet from both the standpoint of meeting mission requirements and safety. Aging weapon systems, decreased manning, and lower experience levels place an ever increasing burden on the individuals performing routine maintenance. There are limits to the capability of all of us and this study seeks to determine if a limit has been reached in the missile facilities career field.

We wish to thank our thesis advisor, Lt Col Russell Lloyd for his assistance in the conduct of this study. We also wish to thank the men and women of the missile facilities career field who responded to our survey without whom this effort would not have been possible. A special thanks goes to Lt Col Denny McMahan and Maj Bill Cooper at HQ SAC for their assistance and advice. Finally we would like to thank our families, Penny, Lauren, Adam, Mike, and Megan for their special understanding and sacrifice during this effort.

S. Clark Popp

Karen Selva

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Abstract

Since the consolidation of several civil engineering career fields into one generalized Minuteman facility maintenance specialty there has been debate over whether it resulted in more effective maintenance and better trained technicians, or whether personnel proficiency and hardware conditions have deteriorated. To study this question historical data from 3901st Strategic Missile Evaluation Squadron reports was analyzed in terms of personnel proficiency ratings and diesel pass rates. Additionally, a survey of the technicians was conducted to determine their perceptions of their performance. Results indicate personnel proficiency and diesel pass rates have declined since the consolidation of the specialties, and corrective action will be complicated by technicians perceptions of their adequate job proficiency. Recommendations include dividing the technicians into specialized maintenance areas, modifying training programs to accommodate this specialization, increasing the time required for upgrade to the five skill level, emphasizing adequate feedback at all levels of supervision, and improving the information maintained in evaluation archival records.

MINUTEMAN MISSILE FACILITIES MAINTENANCE TECHNICIAN (AFS 445X0G): ANALYSIS OF THE EFFECTS OF AFSC CONSOLIDATION ON PERSONNEL PROFICIENCY AND HARDWARE CONDITIONS

I. Introduction

Background

At the inception of the Minuteman Missile program in 1961 there were five civil engineering career fields tasked with maintaining environmental control and diesel power generation systems. These specialties were Minuteman Missile Facilities technician (AFS 541X0G), Minuteman Missile Electrician (AFS 542X0G), Plumbing, Ballistic Missile technician (AFS 552X54), Refrigeration technician (AFS 545X0G), and Power Production technician (AFS 543X0G). Civil engineering technicians carrying these specialties were assigned directly to the Minuteman maintenance organizations as opposed to typical civil engineering squadrons. However, missile maintenance managers found it difficult to maintain manning levels or an adequate experience-base in these specialties because of overseas levies against civil engineers. As a result, technicians just beginning to understand the Minuteman system rotated overseas back into more typical civil engineering assignments. This was particularly common during the Vietnam War when rotations were occurring more frequently to fill short tours. Moreover, the civil engineering career field did not have a special duty identifier that associated certain specialties with the Minuteman weapon system, therefore, there was little to guarantee that the technicians would be returned to the weapon system on their next rotation.

In 1972 the Minuteman Missile Electrician and the Plumbing, Ballistic Missile specialties were merged into the Minuteman Missile Facilities specialty. (USAF, 1982) Despite this initial consolidation, some specialization continued around refrigeration, power production, and electrical areas. This was noted as a problem area in a 1976 Occupational Measurement Center (OMC) study of the AFS 541X0G career field. (USAF, 1976)

Action was begun in 1976 to correct the manning and experience problem by creating a specific career field for Minuteman maintenance, called the Facilities Maintenance Technician (AFS 445X0G). Additionally, policy and organizational changes were instituted to further reduce specialization within the career field. (USAF, 1976) This involved a realignment of all the environmental control system (ECS) and power production tasks previously performed by the 54XX0G and 554X54 specialties, with the majority of this responsibility being assigned to the new facilities maintenance technician. Over time additional tasks distributed to other missile maintenance technicians have also been given to the facilities maintenance technician. The result is a Specialty Training Standard (STS) of over 600 line items. (USAF,1983b)

Debate has gone on for several years over the question of whether this consolidation has resulted in more effective maintenance and a better trained technician, or whether personnel proficiency and hardware condition have deteriorated. It is suspected by some that a problem may exist, but a recent Occupational Survey Report (USAF, 1982), generated at the request of Strategic Air Command/Directorate of Missile Maintenance, "did not support further subdivision of the 445X0G career

ladder since members did not clearly specialize in power production, ECS, plumbing, or electrical jobs." As a result, efforts to further subdivide the career field have ceased. Other corrective actions to the suspected problem have been initiated, such as changing the repair manuals from the Civil Engineering Manual type to the more common form of technical data which explicitly directs repair actions.

It is the opinion of the authors that the Occupational Survey Report missed the point. Essentially, the AFS 445X0G Specialty Training Standard was evaluated to determine if the tasks specified in it were indeed accomplished by the technicians, and if those tasks being accomplished were emphasized in the Chanute AFB technical training program. In addition, the survey sought to determine "whether 445X0G personnel specialized sufficiently in air conditioning, plumbing, electrical, or power production jobs to justify further subdivision of the career ladder." (USAF, 1982) While it did address which tasks are accomplished by the technicians, the Occupational Survey Report did not address the key issue: Are those tasks that are accomplished done so proficiently?

Problem Statement

The consolidated AFS 445X0G has solved the manning problem of sufficient numbers of facility maintenance technicians, but the relationship between consolidation and the apparent declining personnel proficiency rates and hardware conditions has not been determined. Personnel proficiency of the technicians assigned to this career field appears to be decreasing, and associated with this is an apparent decline in the condition of the hardware maintained by these

individuals. This problem was first recognized in the 1981 3901st Strategic Missile Evaluation Squadron Commanders' briefing (USAF, 1981a) to the CINC SAC where he stated:

> . . . personnel proficiency in the facility maintenance areas (affected by the 445X0G) appears to be consistently low because of a combination of low experience level of technicians, complexity as well as wide diversity of technical duties . . . .

Again in 1983 the problem received command attention when the VICE CINC SAC was briefed during the Quarterly Executive Management Briefing (USAF, 1983a) that:

> An analysis of evaluation for FYs 81, 82, and through June 83 highlights a problem in the area of power and environmental control system maintenance -- our Facility Maintenance teams and Periodic Maintenance teams.

The briefing goes on to highlight the fact that facilities maintenance technicians' failures represent an increasing percentage of total wing failures.

A determination of the actual impact of the AFSC consolidation on personnel proficiency and hardware condition must be made. Should a negative impact be indicated then corrective action must be identified as well.

Research Objectives

Objective 1: To determine the effects of the consolidated AFSC (445X0G) on the personnel proficiency of the technicians assigned to that specialty, and on the condition of Environmental Control System and Power Production System hardware.

Objective 2: To determine the perceptions of individuals assigned to the 445X0G AFSC on their ability to perform their assigned duties.

Objective 3: If declining personnel proficiency and/or deteriorating hardware conditions are indicated, to determine possible causes for the problems, and to recommend solutions to these problems.

Research Questions

Question 1: Has the personnel proficiency of the facilities maintenance technician shown either improvement, deterioration, or remained the same since the consolidation occurred?

Question 2: Has the condition of the hardware maintained by facilities maintenance technicians shown either improvement, deterioration, or remained the same since the consolidation occurred?

Question 3: Has the consolidation of the specialties resulted in too much task complexity and/or task diversity?

II. Literature Review

The literature review was conducted with two purposes. First, the review was developed to support the findings for research question 3. Second, it establishes a knowledge base on which to draw conclusions and make recommendations. The review is sectioned into three major areas: Job Characteristics Models, Role Overload, and Learning and Training Theory.

Job Characteristics Models

Hackman and Oldham Model. The characteristics of a job, and their relatationship to job satisfaction, has been a well-developed area of study. Some of the most prominent research has been conducted by Hackman and Oldham. Their theory states that there are certain characteristics of a job that affect a worker's psychological state and, in turn, the level of job satisfaction and motivation. (Figure 1) (Hackman,1983; Hackman and Oldham,1976)

There are three psychological states that are considered to be critical to satisfaction and motivation. The first is "experienced meaningfulness of the work" where the worker feels he is of worth and value (self-esteem). The second is "experienced responsibility" for the outcome of work. The third critical psychological state is "knowledge of the results" of work effort. Hackman and Oldham postulate that the worker will experience positive work outcomes to the extent that these three psychological states are satisfied. (Hackman and Oldham,1976)

The job characteristics Hackman and Oldham (1976) considered important include skill variety, task identity, task significance,

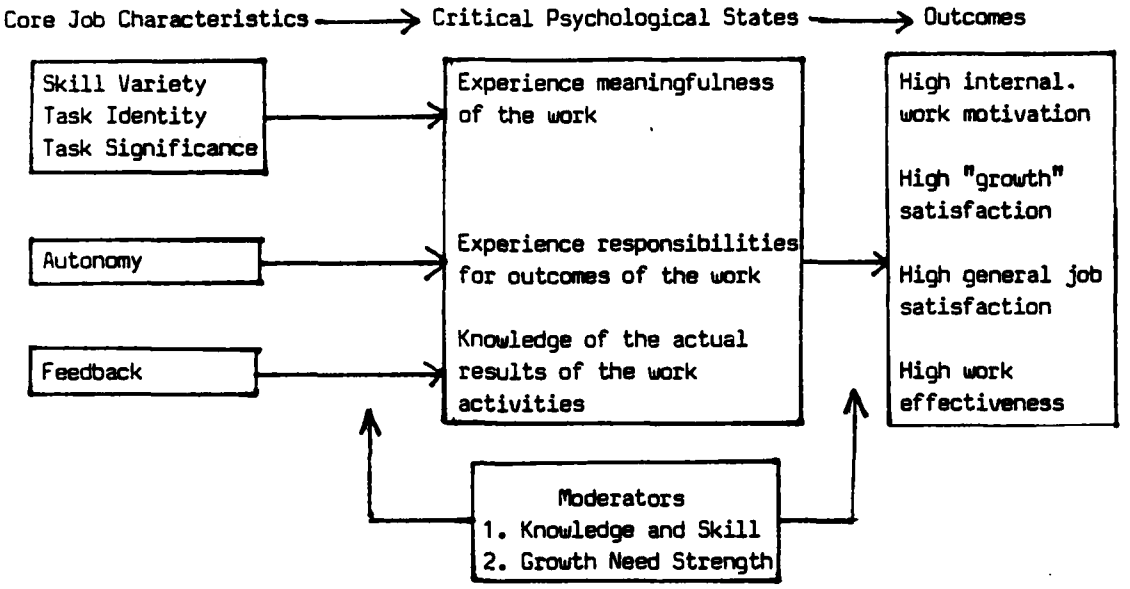


Figure 1. Job Characteristics Model (Hackman, 1983)

autonomy, and job feedback. Hackman and Oldham (1976) define skill variety "as the different activities involved in doing the job, and the different skills and talents utilized in doing the job." Task identity is defined as the degree to which an "individual identifies with a completed job," and task significance as "the degree to which the job has a substantial impact on the lives or work of other people . . . ." Skill variety, task identity, and task significance make up the measure of the psychological state of experienced meaningfulness. Autonomy is defined as how much freedom or independence the individual feels about the work. Feedback is defined as ". . . the individual obtaining direct and clear information about the effectiveness of his or her performance." (Hackman and Oldham, 1976) Autonomy measures the psychological state of experienced responsibility for work outcome, while feedback measures the psychological state of knowing the results of the work activities.

Hackman and Oldham (1976) have determined through their studies that the three psychological states have a multiplicative effect on job satisfaction and motivation levels. They developed a formula using their job characteristics measures that provides each job a Motivating Potential Score (MPS). (Figure 2) The higher the MPS score the more

$$MPS = \frac{\text{Skill Variety} + \text{Task Identity} + \text{Task Significance}}{3} \times \text{Autonomy} \times \text{Feedback}$$

Figure 2. Motivating Potential Score Formula
(Hackman and Oldham, 1976)

potential the job has to be motivating. The effect of skill variety, task identity, and task significance as individual measures is considered to be only additive within the framework of the formula. A zero rating on any of these would not have a significant impact on the MPS. However, the multiplicative nature of the other two factors are such that a zero or near zero score would cause a very low MPS score.

The Job Characteristics Model acknowledges moderating variables as affecting the overall MPS. Without specifically identifying the moderating mechanism, they indicate that the moderating variables do affect both the input function to and the output function from the psychological states. While the basic model has remained stable over time, the moderating variables have fluctuated. In 1976, Hackman et al. (1976) completed a study on job context and growth need strength as moderating variables of the MPS. Job context refers to the pay, job security, relationships with co-workers and supervisors, and in general, the overall working conditions. (Hackman and Oldham, 1980) Growth need

strength refers to the internal need for personal growth and accomplishment. (Hackman and Oldham, 1980) In their study of 242 bank employees they found that when the desire for complex challenging jobs is high the growth need strength was also high. Additionally, job context satisfaction showed positive correlation with the more complex jobs.

By 1980 Hackman and Oldham were including a third moderating variable -- knowledge and skill. Adequate levels of knowledge and skill tend to reinforce the positive feelings people had about their jobs. Insufficient levels of knowledge and skill would cause workers to be frustrated by the job, and therefore, be less satisfied.(Hackman and Oldham, 1980; Hackman, 1983) The effects of these moderating variables have not yet been systematically tested, and what evidence exists is "scattered and inconsistent." (Hackman, 1983) In a review of his Job Characteristics Model, Hackman (1983) had deleted context satisfaction as a specific moderating variable.

Other Models. Others have studied and tested the Hackman and Oldham model. Stone (1976), for example, defined his model in terms of job scope (Figure 3). The results of Stone's 1976 study showed ". . . the greater the scope of a job the more satisfied are its incumbents with the work itself."

Another variation on the subject was Umstot et al. (1976) who looked at the relationship between job enrichment and goal setting on

Job Scope = (2 x Variety) + (2 x Autonomy) + Task Identity + Feedback

Figure 3. Stone's Job Characteristics Model (Stone, 1976)

productivity. The results of their study showed that job enrichment had a positive effect on job satisfaction but had little effect on productivity, while goal setting and job enrichment together had a positive effect on employee productivity.

Most studies have dealt with the enlargement of jobs to increase job satisfaction and employee performance. Little or no research has been conducted on how far to enlarge jobs. Lawler (1969) states:

> In fact, it would seem that jobs can be overenlarged on the horizontal dimension so that they will be less motivating than they were originally. Excessive horizontal enlargement may well lead to a situation where meaningful feedback is impossible, and where the job involves using many additional abilities that the worker does not value.

Schwab and Cummings (1976) put forth a number of hypotheses on job scope and its relationship to performance. They define job scope as both "vertical (enrichment) and horizontal (enlargement) dimensions of the responsibility and/or activities within a task." Performance is affected only as task scope interacts with ability and motivation.

Schwab and Cummings (1976) hypothesize that each individual has an optimal task scope that maximizes their own abilities; that as task scope increases relative ability will at first increase to the optimal level but then decrease; and the negative performance consequences are greater for excessive task scope. This is graphically represented in Figure 4. They state that areas of task scope to both the right and left of the optimal point are "dysfunctional for performance," but more so as task scope increases past the optimum point.

In support of that theory is the study by London and Klimoski (1975). They studied the effects of self-esteem and job complexity as moderating variables of job performance and satisfaction. Their results

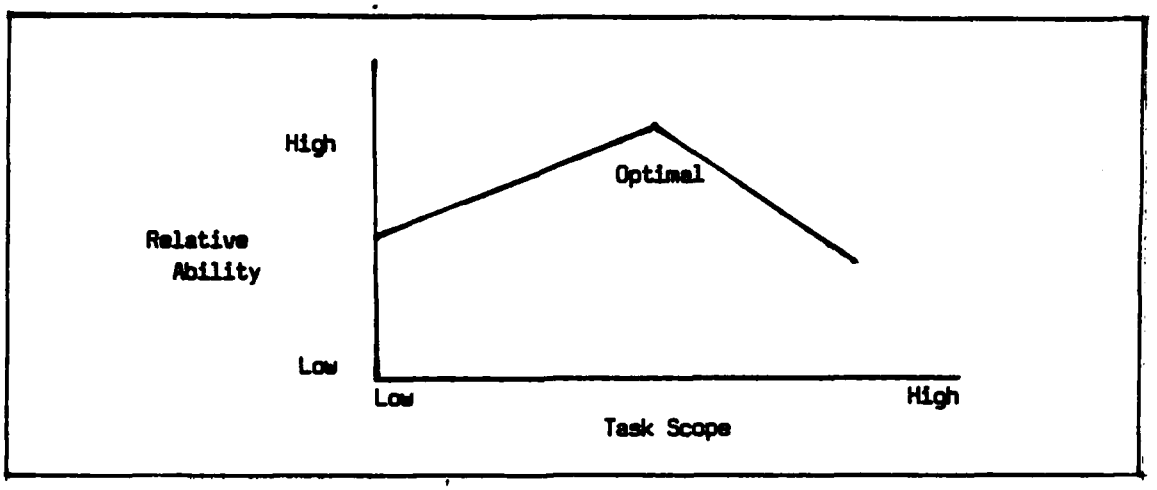


Figure 4. Relative Ability of Performance to Task Scope

showed self-esteem did not significantly moderate job performance or satisfaction. The important variable was the perceived complexity of tasks involved.

Activation theory suggests the relationship between job (task) complexity and job (task) performance is curvilinear. (Scott, 1966) Gould (1979) took this theory and applied it to the job complexity and satisfaction relationship. He found a curvilinear relationship between job satisfaction and complexity like a U shape. (Figure 5) When routine jobs of low complexity, completed with little conscious effort, increased in complexity, satisfaction declined. A dull job made harder

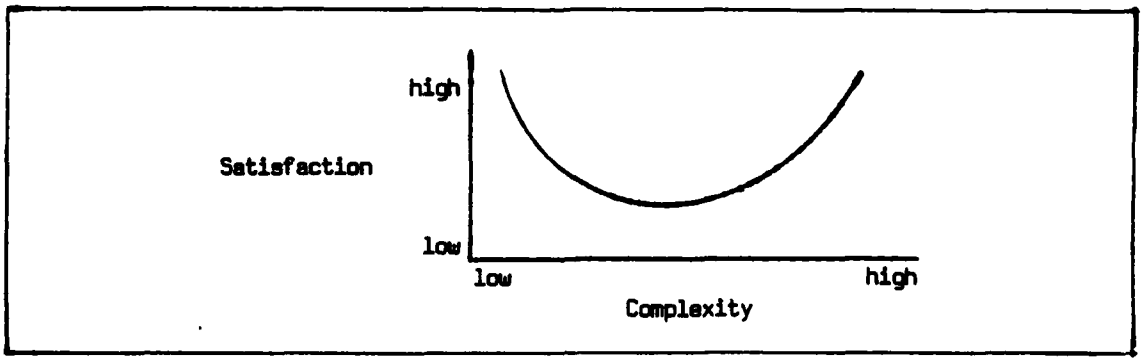


Figure 5. Job Satisfaction-Complexity Relationship (Gould, 1979)

is still a dull job. There comes a point, however, where increasing complexity causes an increase in challenge and the result is a rise in job satisfaction.

In sum, research on job characteristics models indicate there are characteristics of each job that affect the psychological state of the worker and have an effect on the experienced job satisfaction and motivation levels of the worker. Modification of these job characteristics will affect the satisfaction and motivation of the worker. Primary research emphasis has been on increasing the scope and depth of jobs. More recent studies indicate there may be an optimal level to broaden job scope after which negative performance consequences will result. Moderating variables are acknowledged to exist and include knowledge, skill level, and job complexity.

Role Overload

As mentioned earlier several researchers have theorized on the effect of too much task variety, but it is only in the last decade or so that serious attention has been paid to task (role) overload as a detriment to job performance. The primary focus of interest has been on the individual strain resulting from two organizational stresses dealing with job complexity: role conflict and role ambiguity. It is under the research of role conflict that role overload is discussed. Role conflict is the situation where information regarding different aspects of a job are in conflict. (French and Caplan, 1972) It occurs when the expectations of one or more role senders differ from the worker's own, when different requirements of the job interfere with each other, or when too many roles are expected overall (role overload).

"Role ambiguity is a state in which a person has inadequate information to perform his role." (Miles and Perreault, 1976; Van Sell et al. 1981)

There are two forms of role overload: quantitative and qualitative. Quantitative overload, without regard to task complexity, refers to an excessive number of task requirements levied on the worker. Qualitative overload occurs when the worker has neither the required abilities, skills, and/or knowledge to complete the job. (French and Caplan, 1972)

Research into these areas have used objective and subjective measurement criteria to assess their effects. Objective measurements have come from performance reports, turnover and absenteeism rates, and physiological effects (heart rate, respiration, etc). The subjective measurements have come from surveys and interviews looking at job involvement, tension, threat, anxiety, satisfaction, and propensity to leave. (Van Sell et al. 1981) It is interesting to note that variations on the Hackman and Oldham MPS equation have been used by many of the researchers in accessing overall job complexity.

The most widely substantiated results of role conflict are job dissatisfaction and job-related tension. (Brief and Aldag, 1976; Miles, 1975; Miles, 1976; Van Sell, 1981) Although not as widely accepted as such, unsatisfactory work group relations (French and Caplan, 1972), lowered group performance (Liddel and Slocum, 1976), lower individual performance evaluations (Haas, 1964), and unfavorable attitudes toward role senders (Miles, 1976) have all been documented as outcomes of role conflict. Physiologically some of the effects have included fatigue (Beehr et al.; 1976), depression, irritation, (Caplan et al.; 1975), increased heart rate (Caplan and Jones, 1975), a sense of futility, and a lack of happiness (Hall and Gordon, 1973).

Recent research has looked for moderating variables on the effects of role ambiguity and role conflict (role overload). Schuler (1975) found that for individuals higher in the organization role ambiguity had a greater negative impact on job satisfaction than for those at a lower level, while for role conflict the negative effect was strongest for those at a lower level. Additionally, he found for those low in the organizational chain that role ambiguity had a more negative effect on job performance than did role conflict. In 1977 Schuler (1977a) reported that employee ability, characterized by years of work experience and education, and organizational level did moderate the job satisfaction and job performance relationships to role conflict and role ambiguity. Later that year (1977b) he also reported that when task design, organizational structure, and technology were congruent with each other that lower levels of role conflict were experienced.

In sum, research on role conflict (role overload) has shown that workers can suffer from job dissatisfaction, tension, unsatisfactory work group relations, lowered group performance, lowered individual performance evaluation, fatigue, depression, irritation, increased heart rate, sense of futility, and a lack of happiness.

Learning and Training Theory

Although most of the literature and research dealing with learning theory deals with the acquisition of cognitive tasks, some researchers have looked at the learning and teaching of complex psychomotor skills. A large protion of this literature has been done by or for the Department of Defense.

Gagne (1971) discusses the relationship between learning theory and the training of complex tasks. He states that general principles of learning do not necessarily apply to teaching and learning of psychomotor skills. He likens troubleshooting complex equipment to the medical professions' diagnosis procedures. "This [finding malfunctions in complex equipment] is in many respects a most complex kind of behavior [Gagne,1971]." How then is diagnosing malfunctions taught? Gagne states ". . . the idea of learning to troubleshoot by simply practicing troubleshooting verges on the ridiculous." People learn to troubleshoot by learning a "set of rules" and a "class of tasks." There is no single task to learn or practice.

Anderson (1982) discusses the acquisition of skills taking place in three stages: cognitive, associative, and autonomous. In his research the learning of skills is considered the learning of a system of "procedural knowledge" acts and declarative knowledge. "Procedures" control the cognitive steps taken in the performance of tasks. The human compilation of these procedures is gradual. Introduction of new procedures to "evolving individuals" can have grave consequences, in that the new procedures can disrupt the smooth functioning of what is already there. The gradual increase of new procedures provides protection against errors being built in the learning process. (Anderson,1982)

The role of retention in learning was investigated by Hagman and Rose (1983), who contend we know little about the retention of skills. Hagman reviewed studies on the retention of skills looking for those variables which affect retention. His position is that if these variables are controlled retention can be improved. He came up with

three approaches to improving retention based on these variables: 1. improve training; the primary determinate of retention is how much of the task or how well the tasks was learned initially. 2. minimize retention loss by modifying the task. 3. select and assign only those individuals whose abilities are most suited to the task. Hagman and Rose (1983) also point out the need for repetition during and after training to insure retention.

Gagne (1970) provides further insight into conditions that affect the individuals ability to remember:

> Remembering is highly subject to reduction by a number of factors, including particularly (1) the number of learning events that occur in a given time interval; (2) the presence of distracting (or "interfering") activities following learning; and (3) the passage of time (which may also include interfering activities).

Another point Gagne (1970) makes is how much and what needs to be remembered from a particular learning experience. Often only enough need be remembered to allow the individual to look up needed information from reference sources. There is an advantage to remembering though for the problem solver, he does not have to "look up" or relearn tasks or skills. Landy and Trumbo (1980) also point out factors that affect retention and remembering. The effects of other activities and other learning taking place both affect how well individuals retain what was learned.

In sum, research implies the individual does not have a maximum learning/training capacity. However, the amount of material the individual retains will be affected by the amount of material taught in a given time period, the amount of outside interference, and the time between learning and reinforcement.

III. Methodology

The three research questions posed in chapter one are shown again below.

1. Has the personnel proficiency of the facilities maintenance technician shown either improvement, deterioration, or remained the same since the consolidation occurred?

2. Has the condition of the hardware maintained by facilities maintenance technicians shown either improvement, deterioration, or remained the same since the consolidation occurred?

3. Has the consolidation of the specialties resulted in too much task complexity and/or task diversity?

Three distinct research methods were used to answer these questions and support the research objectives. The three approaches were: analysis of historical data on personnel proficiency and hardware condition obtained from the 3901st Strategic Missile Evaluation Squadron (SMES); administration and analysis of a survey of AFS 445X0G technicians prepared by the authors; and an in-depth review of the available literature on job characteristics models, role overload, and learning and training theory. This chapter discusses each of these approaches, concluding with a discussion of how they support the research questions.

3901st SMES Historical Data

Obtaining the Data. The 3901st SMES was contacted to determine if archival records were maintained on Minuteman wing evaluations. The records were maintained as far back as 1969 and copies were made available to the authors upon request.

Sample Characteristics. The sample population for this study was comprised of the missile maintenance technicians responsible for

maintaining the environmental control, power generation, and power distribution systems during the period 1969 to 1983. This population has varied in terms of the AFSCs that have performed facilities maintenance. From 1969 to 1974 facilities maintenance was performed by Civil Engineering trained technicians. The AFSCs were Minuteman Missile Facilities specialty (AFS 541X0G) and two parallel specialities: Minuteman Electrician (AFS 542X0G), and Plumbing, Ballistic Missile (AFS 552X5Y). Additionally, there were Refrigeration (AFS 545XXX) and Power Production (AFS 543XXX) technicians assigned. In 1974 AFS 542X0G and AFS 552X5Y were merged into the AFS 541X0G. Also during this time period, training for these technicians moved from Sheppard AFB to Chanute AFB. Efforts began in 1976 to consolidate all facilities maintenance specialties into one missile maintenance managed career field (AFS 445X0G). In conjunction with this, all Civil Engineering specialties assigned to missile maintenance squadrons were eliminated. By 1980 the consolidation process was completed.

The technicians were assigned to one of six Minuteman ICBM wings or the missile test squadron at Vandenberg AFB.[1] For this study the sample population excluded technicians assigned to the Power, Refrigeration, and Electrical Shop and the Mechanical Shop where maintenance tasks are focused on in-shop repair work. The sample population is predominantly male, includes the ranks of E2 through E9, and ranges in work experience from 9 months to 30 years of military duty.

[1] Minuteman wings are located at Ellsworth AFB SD, F.E. Warren AFB WY, Grand Forks AFB ND, Malmstrom AFB MT, Minot AFB ND, and Whiteman AFB MO.

Generation of 3901st SMES Historical Data[2] The 3901st SMES evaluates the personnel proficiency and hardware conditions of each missile wing on a cyclical basis. Over the years this cycle has fluctuated between once every six months to once each year. During the wing evaluation a specified number of technicians from each missile maintenance specialty are evaluated on a predetermined number of tasks. These tasks are derived from a "Critical Task Listing" (CTL) of those tasks considered essential to the safe and effective maintenance of the weapon system. The number of technicians selected for evaluation is based on a percentage of the personnel authorized for each wing. As a result, the actual number of technicians evaluated will vary from wing to wing.[3] Overall, the number of actual tasks is adjusted for approximate equality between each wing. The technician is subject to evaluation on any task he is annotated as qualified on in his Job Qualification Standard (JQS). Additionally, a limited number of technicians are qualified on various seldomly performed tasks.

The 3901st SMES evaluation is a scheduled event. The missile wings have in-depth preparation programs designed to insure all personnel and equipment are in optimum condition. Prior to their arrival the evaluation team notifies the wing of the CTL tasks to be evaluated, and it is the wing's responsibility to build them into the projected maintenance schedule. This provides the wing some latitude in selecting technicians for evaluation. The remaining tasks to be evaluated are selected from the normal daily maintenance schedule.

[2] Description of 3901st SMES evaluation program taken from SACR 55-47 and SACR 66-12 Vol V

[3] The number of technicians authorized each wing varies based on the number of missiles assigned.

Each FMT evaluation occurs at either a Launch Facility or a Launch Control Facility. Some evaluations will be portal-to-portal, meaning from departure to return to the missile support base, while the remaining ones will be no-notice evaluations where the evaluators show up at the site with a maintenance task already in progress. In the latter case the tasks evaluated will be primarily AFS 445XOG particular (e.g. diesel checkout/repair) as opposed to more generalized missile maintenance tasks in the former case (e.g. site penetration).

During an evaluation the 3901st SMES evaluator observes the technician in the performance of several tasks. He looks for technician compliance with technical data procedures and he notes any and all deviations. SACR 66-12 establishes three categories of errors, as well as the number of error types required to pass or fail an evaluation. (Appendix A) A passing score results in a "qualified grade" for the technician while a failure is an "unqualified grade" (UQ).[4] One unqualified grade on a task, regardless of the number of tasks evaluated, will result in an overall unqualified grade for the technician; however, it takes a percentage of failures, specifically ten percent, for an entire maintenance branch to fail.

Data Characteristics. The data is a compilation of the 3901st SMES evaluation pass/fail rates drawn from evaluation reports since 1969. During the period 1969 to 1978 the report generated after each evaluation showed one pass rate for an entire missile maintenance organization at each wing. For the period 1979 to present the pass rates were subdivided for each maintenance branch at each wing. Each

[4] "Highly Qualified" grades can be awarded for truly outstanding "Qualified" performers.

report contains narratives describing the circumstances of the errors and the type of teams committing the error.

Throughout the period of consideration (1969 to 1983) there have been variations in the grading criteria used by the 3901st SMES evaluators. For instance, in the period prior to the 1976 AFSC consolidation there was a "systems knowledge" error awarded when evaluators felt the technicians should have solved a problem using their knowledge of the system even though the problem extended past the technical data. (Meyers, 1984) At the time of the AFS 541XOG consolidation in 1976, this error category was eliminated and technicians were no longer permitted to extend past their technical data to correct the problem. Finally, there have always been variations in the subjective influence of the grading as changes of 3901st SMES commanders brought varying philosophies.

Limitations of the Data. It is obvious from the earlier discussion that the technician sample is not random. The wings have some latitude in assigning technicians for previously identified tasks and it can be assumed that they will endeavor to schedule only those individuals they feel confident will pass the evaluation. The assignment of individuals for qualification of seldomly performed tasks is non-random as well. Generally speaking, technicians who have previously demonstrated proficiency in similar areas are trained in these tasks. Moreover, a technician can be evaluated more than once in a "random sampling". Whether a 3901st evaluator chooses to follow through with such an evaluation is a subjective decision. This is only important if you consider that a technician can be evaluated on different tasks requiring the same skills (eg. troubleshooting) and fail both times.

The format of the data itself is an additional limitation. The type and quantity of statistics computed after each evaluation has varied over the years, and this determined the type of analysis the authors performed. For the period 1969 to 1978, only the wing missile maintenance organization pass rates are available with narratives describing the errors. Beginning with the 1979 evaluation cycle, the reporting format was changed to show a breakout of the pass/fail rates by the different maintenance duty sections (e.g. FMT, PMT). Therefore, for the period 1979 to 1983 the exact pass rate for AFS 445X0G technicians is available.

Method of Data Analysis. To arrive at a common measure for this divergent data, the narrative descriptions found in each report were screened to determine if an unqualified grade had been awarded to a facilities maintenance technician. These were totaled for each wing, and this number was then divided by the total number of unqualified grades received by the maintenance organization to derive the ratio shown below:

$$\% \text{ of FMT UQs} = \frac{\text{total \# of unqualified grades for facility maintenance technicians}}{\text{total \# of unqualified grades for all maintenance technicians}}$$

This product represents the percentage of unqualified grades attributable to facility maintenance technicians.

The hardware condition was measured by counting the number of hardware discrepancies in the report directly attributable to power production or environmental control maintenance actions. Next, a diesel pass rate was determined by dividing the number of diesels passing the diesel run test by the total number tested. A failed diesel was one

that failed to start, failed to assume the load, or failed to consistently carry the load for a minimum of 30 minutes.[5]

Statistical Tests. The percentage of facility maintenance technician errors for each missile wing was graphed to determine if an obvious trend, either positive or negative, was present. A one-way analysis of variance was conducted to test if the means for the percentage of facility maintenance technicians unqualified grades differed to a statistically significant extent over the 1969 to 1983 time period. The same test was conducted to determine if the means for the diesel pass rates and overall personnel proficiency pass rates for each year varied to a statistically significant degree. Additional statistical tests were conducted on the data by dividing the period of consideration into two subgroups based on when the consolidation began and when the technical training program for these specialties was transferred from Sheppard AFB to Chanute AFB. A 95 percent confidence level was used for each test.

Survey of AFS 445X0G Personnel

Justification of Survey. Notwithstanding what the 3901st SMES objective data might suggest is the state of personnel proficiency and hardware condition, the perceptions of missile maintenance personnel is a vitally important factor in the investigation of the research questions. Even though a problem people perceive as present does not exist, the fact that they perceive its presence can be a problem in itself. One method of determining the presence of individual perceptions is through the use of a survey, a method that has been well tested and is an accepted convention in the field.

[5] "Assuming the load" refers to the diesels ability to carry the electrical requirements for the missile site.

The Instrument. The survey developed contains 70 individual questions divided into seven sections, each designed to gather specific information from the facilities maintenance technicians. (See Appendix B)

Section I Background. The background section includes questions of the respondents designed to provide a more precise definition of the population. Some of the data gathered includes the technicians' age, education and skill levels, career field experience, duty position, and base of assignment. This data is correlated against data collected in the other sections. This section has eleven questions.

Section II Work Attitudes. Questions on job satisfaction and the quality of supervision are included in section two. The questions were drawn from existing, validated surveys on worker attitudes. This section has ten questions.

Section III Relative Time Spent on Maintenance Tasks. Section three gathers data on the technician's perceptions as to the relative amount of time the technician spends performing each of six major maintenance task areas: checkout and/or repair, and troubleshooting of the power production, environmental control, and power distribution systems. The purpose of this section is to determine if, according to their perceptions, technicians are specializing in one of these areas. This section has seven questions.

Section IV Personnel Proficiency Perceptions. This section seeks to determine if respondents perceive themselves to be competent in the performance of their jobs. Questions of competency are asked in

both the area of power production and environmental control. Additionally, respondents are questioned about their perceptions of the technical assistance provided by their supervisors. This section has fifteen questions.

Section V Training Perceptions. Respondents are asked in this section whether they utilize their training and how good their training was in terms of quality. Again, specific questions are asked on power production and environmental control systems training. This section has ten questions.

Section VI Supervisor Perceptions. Response to this section is limited to supervisors. Supervisors are asked questions about their perceptions of technician's performance. Additionally, two questions are asked to determine if supervisors perceive that they are utilizing technicians in a specialized manner. This section has twelve questions.

Section VII In Your Opinion. Five open-ended questions are asked in this section. The questions deal with personnel proficiency, hardware conditions, training, and management of the career field. Respondents are asked to provide recommendations and criticisms in these areas.

Limitations of the Survey. A field-tested instrument with established psychometrics of validity and reliability did not exist, so a new instrument had to be designed. (see Appendix B) Time limitations prohibited pre-administration of the survey to validate the questions. While doing the data analysis the authors were forced to eliminate several of the questions. Some of them were leading questions where improper word choice limited the possible responses to only one or two choices. Several of the response scales failed to attain the degree of

differentiation necessary to analyze the results.

Sample Characteristics. The population for this study was comprised of the facilities missile maintenance technicians responsible for maintaining the environmental control, power generation, and power distribution systems. It excluded technicians assigned to the Power, Refrigeration, and Electrical Shop and the Mechanical Shop where maintenance tasks are focused on in-shop repair work. Therefore, the members of the population were assigned to either the Facilities Maintenance Branch (FMB) or the Deputy Commander for Maintenance staff. Finally, each technician surveyed already begun the Team Training Branch FMB program. The population is predominantly male, includes the ranks of E2 through E9, and the work experience ranges from approximately 9 months to 30 years of military duty.

Method of Data Collection. The survey was administered through the Training Control Division of each missile wing and the test maintenance squadron. Training control was selected as the administrator because they conduct classes routinely and own the classroom facilities. Training control officers were used as points of contacts. Survey booklets and answer sheets were sent out with administration instructions to standardize the administration of each survey. Administrators were asked to maintain control over booklets and answer sheets and not allow respondents to remove material from the classroom area. Administration was conducted following routinely scheduled classes. When all surveys were complete, all materials were returned to the authors. Participation in the survey was voluntary.

Survey Administration. The survey was written by the authors in February 1984. Since it was a newly constructed survey instrument,

without prior validation, and with insufficient time to complete a trial administration, the survey was presented to eight maintenance officers for review. Based on their comments and analysis of the content, readability, and basic understanding of the survey it was revised and submitted to the Air Force survey approval process. The Military Personnel Center approved the survey in March 1984 and assigned it an Air Force Survey Control Number (SCN 84-21). In April 1984 the survey was sent to the six Minuteman wings and the test wing at Vandenberg AFB.

To avoid confusion the only point of contact with each base was the Training Control Officer. They were contacted by telephone prior to the shipment of the survey and periodically throughout the survey administration process. Each Deputy Commander for Maintenance was sent a courtesy letter explaining the purpose of the survey, the administration process, and soliciting their support. The bases were given until 30 April 1984 to complete the survey administration.

Problems were encountered in the administration of the survey when the Strategic Air Command world-wide exercise, Global Shield, began one week after the surveys were received and before very many had been administered. Global Shield is an annual, unannounced exercise which requires all recurring training programs to be cancelled; thus the survey administration was set back one week since recurring training periods were the administrative vehicle. A second setback occurred when within a few days following the completion of Global Shield a severe snowstorm struck the upper midwest of the United States resulting in three of the survey bases being closed down for several days: Minot AFB, Malmstrom AFB, and Ellsworth AFB. The severe weather at these wings required the facilities maintenance technicians to work overtime and

resulted in the continued cancellation of training. Consequently, these bases were three weeks behind schedule at the end of the administration period and poor survey return rates were experienced for them. Malmstrom AFB, struck hardest by the storm, returned only one survey by the 30 April 1984 cut-off date. Therefore, Malmstrom AFB was allowed to complete the surveys after the normal administration period was completed. All surveys were returned to the authors by 15 May 1984.

Method of Data Analysis. The optical scan sheets provided to the respondents were machine scored using the Harris computer at AFIT. The Statistical Package for the Social Sciences (SPSS) was used to conduct statistical analysis for the survey results. SPSS programs Frequencies and Condescriptive were run to generate descriptive statistics such as mean, mode, skewness, and kurtosis. The SPSS program Crosstabulations was used to crosstabulate several of the Section I background questions against the remaining survey questions. This allowed the authors to differentiate responses between the various sub-groups of the respondent population (e.g. team chief vs staff member, PMT vs FMT).

The open-ended questions were read and the answers were categorized into groups of similar responses. The categories were assigned response numbers and the information input to the master data file to allow for computerized statistical analysis. In those instances where the respondent provided more than one comment to a question the first two responses were input to the data base. There was only a few respondents who provided more than two responses and these were not enough to justify enlarging the data base. The SPSS programs were used to generate statistical data and to crosstabulate the responses against those in Section I background question.

Statistical Tests. Student-t tests were conducted to determine if means between various sub-groups were statistically different from each other.

Application of the Literature Review

The literature review was conducted to provide a knowledge base to understand the results of the analyses, and to answer research question four: has the consolidation of the specialities resulted in too much task complexity and/or task diversity? Three specific areas were reviewed to gather the supporting information: job characteristics models, role overload, and learning and training theory. Job characteristics models, as epitomized by the Hackman and Oldham model, provide a breakdown of the components of jobs and the effects these components have on job performance and job satisfaction. The review aided in the development of the survey and in its eventual analysis.

One focus of job characteristics models has been on the increase of skill variety to increase job satisfaction, yet they have not considered the situation of too much variety negatively affecting satisfaction and performance. The authors reviewed another area of research, role overload, to determine if the Specialty Training Standards (STS) for facilities maintenance technicians is too large and too diverse in composition. The review was to provide possible causes for role overload and the situations in which it could occur.

The area of learning and training theory was reviewed to determine if technician training programs could cause or alleviate role overload situations. Additionally, this area provided information on the effects

of learning and training complex skills on retention and job performance. Section V, Training Perceptions, of the AFIT Survey was constructed based on information learned during the review of this area.

Application of Methods

Research Question One. Has the personnel proficiency of the facilities maintenance technician shown either improvement, deterioration, or remained the same since the consolidation occurred?

The 3901st SMES historical data was used to determine whether facilities maintenance technicians' personnel proficiency as evaluated by 3901st SMES had changed to a statistically significant degree since 1969.

The survey instrument was used to determine technician perceptions about their own job performance and proficiency both under evaluation and day-to-day. Specific questions were asked about their performance during 3901st SMES and local quality control evaluation. Additionally, supervisors were asked their impressions on technician performance, and what changes they have observed since the consolidation of the AFSC.

Research Question Two. Has the condition of the hardware maintained by facilities maintenance technicians shown either improvement, deterioration, or remained the same since the consolidation occured?

The 3901st SMES historical data provided a indication of the hardware condition since 1969. In particular, the analysis of the diesel pass rate indicates hardware condition as well as providing a rough indicator of technician proficiency in maintaining that equipment item.

Within several sections of the survey the technicians are asked questions about their perceptions of hardware conditions and the effects of their job performance on the hardware condition. Supervisors are

asked similar questions on hardware conditions and their perceptions of the effects of consolidation on the condition of the hardware.

Research Question Three. Has the consolidation of specialties resulted in too much task complexity and/or task diversity?

Question three is investigated almost entirely through the information generated by the literature review. Two of the open-ended questions in the survey (Q67 and Q70) also provide technician perceptions on the size and complexity of their Specialty Training Standard.

IV. Findings and Analysis

3901st SMES Historical Data

A total of 120 3901st SMES evaluation reports were analyzed. Each report was categorized by year and base. Annual personnel proficiency pass rates and diesel pass rates were then computed by base and fleet (all operational bases). The fleet rates are computed by averaging the six individual wing pass rates over each annual cycle. "Fleet personnel proficiency pass rate" is the percentage of all missile maintenance technicians (AFS 445X0G, AFS 443X0G, AFS 316X0G) who received a qualified grade or higher. It is an indicator for how well all of missile maintenance has done on the evaluations over time. The "percentage facility UQs" represents the percentage of all unqualified grades attributable to technicians working on facilities maintenance hardware. It represents the portion of all failures attributable to facilities technicians. Finally, the "diesel pass rates" refer to the the number of diesels that pass the diesel test run during the 3901st SMES evaluation. It is used as an indicator of hardware conditions and a rough indicator of facility technicians personnel proficiency. The results, the actual numbers computed and the graphs of these numbers, are presented in Tables I, Table V, and Figure 6.

Visual inspection of the fleet-wide personnel proficiency pass rate in Figure 6 (solid line) shows this rate to be consistent over time. Utilizing the Statistical Package for the Social Sciences (SPSS) a one-way analysis of variance (ANOVA) was conducted on the data points to determine if the mean values were statistically equal. This would

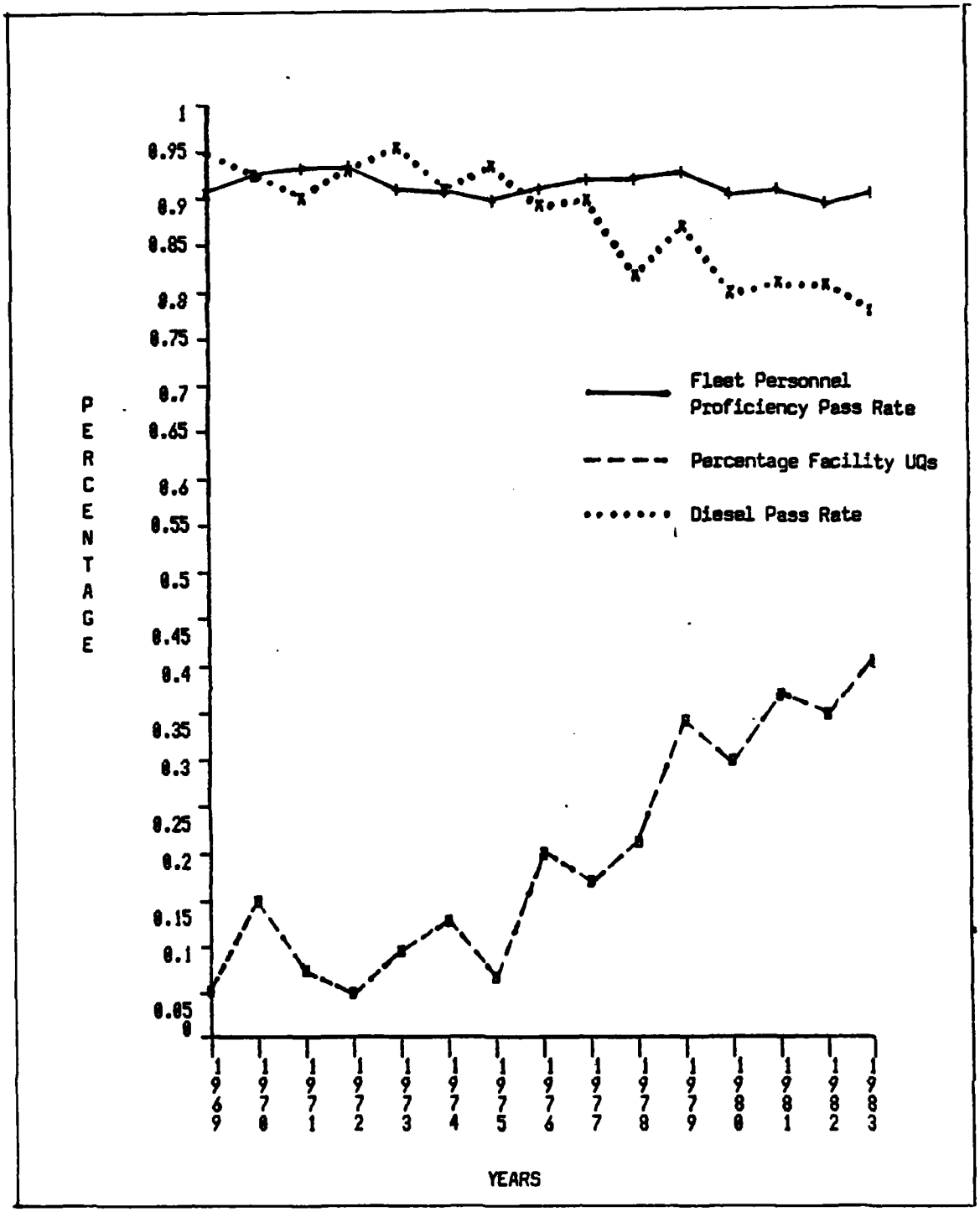


Figure 6. Graphical Results of the Fleet Personnel Proficiency and Diesel Pass Rates, and Ratio of Facilities UQs to Total UQs

TABLE I

Tabular Results of the Fleet Personnel Proficiency and Diesel Pass Rates, and Ratio of Facility UQs to Total UQs

YEAR	FLEET PERSONNEL PROFICIENCY PASS RATES	PERCENTAGE FACILITY UQs	DIESEL PASS RATES
1969	0.9499	0.0526	0.9071
1970	0.9263	0.1515	0.9261
1971	0.9340	0.0769	0.9013
1972	0.9358	0.0516	0.9301
1973	0.9108	0.0959	0.9562
1974	0.9078	0.1283	0.9102
1975	0.8985	0.0696	0.9367
1976	0.9115	0.2000	0.8939
1977	0.9222	0.1714	0.8990
1978	0.9220	0.2134	0.8187
1979	0.9285	0.3448	0.8714
1980	0.9052	0.3000	0.8000
1981	0.9123	0.3708	0.8118
1982	0.8978	0.3506	0.8095
1983	0.9051	0.4054	0.7821

determine if the mean annual pass rates had remained statistically constant since the beginning of the evaluations in 1969. The test hypotheses are:

H_0: the means for the pass rates for the period 1969 to 1983 are equal

H_a: one or more of the means are unequal

A confidence level of 95 percent was selected, for an $\alpha = 0.05$.

The $F_{.05}$, based on 14 numerator degrees of freedom and 72 denominator degrees of freedom, as interpolated from standard F Tables, equals 1.85. This value is greater than the F test statistic (F Ratio) computed in the ANOVA table (Table II), therefore, the null hypothesis (H_0) is acceptable and the means are considered to be equal over time. This shows that over the last 15 years the personnel proficiency pass rate has not changed to a statistically significant degree.

TABLE II

ANOVA Table for Fleet Personnel
Proficiency Pass Rates

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARE	F RATIO
BETWEEN GROUPS	14	181.904	12.993	1.823
WITHIN GROUPS	72	513.057	7.126	
TOTAL	86	694.960		

The percentage facility UQs is the ratio of facility UQs to total UQs. Visual inspection of Figure 6 (dashed line) indicates that over time the ratio has been increasing. A one-way analysis of the data points was conducted to determine if the means remained constant or changed over time. The test hypotheses are:

H_0: the means are equal for the period 1969 to 1983

H_a: at least two of the means are unequal

A confidence level of 95 percent was selected for an $\alpha = 0.05$.

The $F_{.05}$, based on 14 numerator degrees of freedom and 72 denominator degrees of freedom, as interpolated from standard F Tables, equals 1.85. This value is less than the F test statistic computed in the ANOVA (Table III), therefore, the null hypothesis is rejected and at least two means are unequal. This indicates the means are changing but not in which direction, thus requiring another statistical test.

TABLE III

ANOVA Table for Percentage Facility UQs

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARE	F RATIO
BETWEEN GROUPS	14	14944.258	1067.447	9.444
WITHIN GROUPS	72	8137.703	113.024	
TOTAL	86	23081.961		

A Wilcoxon Rank Sum test for independent samples was conducted on the data to determine if the probability distributions for the periods 1969 to 1974 and 1975 to 1983 were the same. The hypotheses are:

H_0: the two populations have identical probability distributions

H_a: the probability distribution for population A, period 1969 to 1974, is shifted to the left of that for B, period 1975 to 1983.

The test statistic is the rank sum T_a, associated with the population with fewer measurements (1969-1974). To reject the null hypothesis (H_0) requires T_a to be less than or equal to T_1. The value T_1 is determined using standard Wilcoxon Rank Sum tables with a confidence level of 0.95, or $\alpha = 0.05$.

$$T_a = 24 \qquad T_1 = 33.$$

Since T_a is less than T_1 the null hypothesis is rejected, and the probability distribution for the period 1969 to 1974 is considered to be shifted to the left of the one for the period 1975 to 1983, indicating the mean is less. This shows the mean percentage facility UQs for the period 1969-1974 is less than that of the earlier preconsolidation period to a statistically significant degree.

Visual examination of the diesel pass rate (dotted line) in Figure 6 indicates this is a decreasing trend over time. A one-way analysis of the data points was conducted using SPSS to determine if the mean annual diesel pass rates were in fact changing. The test hypotheses are:

H_0: the means for the diesel pass rates are equal over the period 1969 to 1983

H_a: at least two means are unequal

A confidence level of 90 percent was selected, for an $\alpha = 0.10$.

The $F_{.10}$, based on 14 numerator degrees of freedom and 72 denominator degrees of freedom, as interpolated from standard F Tables, equals 1.612. This value is less than the F test statistic computed in the ANOVA table (Table IV), therefore, the null hypothesis (H_0) can be rejected and the alternate hypothesis (H_a), at least two means are unequal, can be accepted. This shows that the annual diesel pass rate means are not constant over time. The ANOVA does not, however, determine if the rate is decreasing or increasing. A second statistical test was then conducted to determine in which direction the pass rates are changing.

TABLE IV

ANOVA Table for Fleet Diesel Pass Rates

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARE	F RATIO
BETWEEN GROUPS	14	2533.931	180.995	1.674
WITHIN GROUPS	72	7785.394	108.130	
TOTAL	86	10319.325		

A Wilcoxon Rank Sum test for small independent samples was conducted on the data to determine if the probability distributions for the periods 1969 to 1974 and 1975 to 1983 were the same. A nonparametric test was selected because a test of the variances showed them to be unequal. The test periods were chosen based on the consolidation begining in 1974. A shift in probability distributions would indicate a change in means and the direction. The test hypotheses are:

H_0: the two populations have identical probability distributions

H_a: the probability distribution for population A, period 1969 to 1974, is shifted to the right of that for B, period 1975 to 1983.

The test statistic is the rank sum T_a, associated with the population with fewer measurements (1969-1974). To reject the null hypothesis (H_0) requires T_a to be greater than or equal to T_u (1975-1983). The value T_u is determined using standard Wilcoxon Rank Sum tables with a confidence level of 0.95, or $\alpha = 0.05$.

$$T_a = 70 \qquad T_u = 63$$

Since T_a is greater than T_u the null hypothesis is rejected, and the probability distribution for the period 1969 to 1974 is considered to be shifted to the right of the one for the period 1975 to 1983, meaning the means are greater. This indicates that the mean diesel pass rates for the period 1975 to 1983 are less than those for the earlier period to a statistically significant degree.

The statistical tests used thus far do indicate a shift in the diesel pass rates but it is small, and large variances also are present. Therefore, a forecasting technique was used to see if the decrease in

pass rates would continue. This technique was conducted by Captain Larry Abney in a paper for an AFIT course in Forecasting Techniques (LM 6.30). (Abney, 1984) Captain Abney employed a univariate analysis forecasting technique. The resulting model predicts a continued decreasing diesel pass rate.

Table V presents the tabular results of the number of hardware discrepancies extracted from the 3901st SMES reports. The results show a decreasing number of discrepancies reported over time. This is contrary to the anticipated increase that would occur if personnel proficiency and hardware conditions were, in fact, degrading. Further research into this development revealed that in the 1976 evaluation cycle the manner in which hardware discrepancies were reported was changed by the 3901st SMES. A Detailed Discrepancy Listing (DDL) was created listing all reported "major" discrepancies. Prior to this time

TABLE V

Tabular Results of the Number of Environmental Control and Power Production System Discrepancies

YEAR	POWER PRODUCTION DISCREPANCIES	ENVIRONMENTAL CONTROL DISCREPANCIES	TOTAL NUMBER DISCREPANCIES
1969	32	40	72
1970	29	55	84
1971	25	17	42
1972	40	31	71
1973	34	35	69
1974	20	5	25
1975	14	12	26
1976	14	5	19
1977	11	3	14
1978	24	21	45
1979	7	4	11
1980	11	9	20
1981	20	2	22
1982	19	0	19
1983	17	2	19

all discrepancies were reported in the final wing evaluation report. The DDL listing is not part of the official 3901st report and the wings do not maintain copies on file for more than two years. Due to the unavailability of accurate data this line of investigation was discontinued.

In sum, the 3901st SMES data indicates that while fleet personnel proficiency pass rates have not changed over the last fifteen years the percentage of unqualified grades (UQ) attributable to facility maintenance technicians has increased over the same period. It can then be concluded that facility maintenance technician personnel proficiency is declining. The diesel pass rates have been declining over the same period of time. Therefore, if a diesel's ability to run on demand is an indication of its overall condition, the hardware condition is deteriorating.

AFIT Survey Data Analysis

This section presents the results of the AFIT survey administered to AFS 445X0G facility maintenance technicians. The analysis is divided into sections based on those found in the survey. The sections found relevant to the research questions are discussed and their results presented in tabular form. The questions associated with each section are included in the tables to facilitate easy reference. A total of 341 technicians responded to the survey out of a population of 706 based on 30 January 84 manpower documents from HQ SAC/LGB, resulting in a response rate of 48%. The SPSS program and the data base used for the survey analysis are found in Appendix C and D.

Section I Background Information. This section provides a demographic description of the sample population. These descriptive statistics are provided in Table VI. The data indicates the survey respondents were relatively young, with 60.7% between 20 and 25 years of age and 84% less than 30 years of age. Nearly all the respondents were male (95.9%), and all of them had at least a high school education, with 49.6% having completed some college work.

The majority of the respondents were five-level technicians with less than four years Minuteman experience (55.4%). Primarily they were team members assigned to either the Periodic Maintenance Team or Facilities Maintenance Team section (40.4%). Team chiefs assigned to these two sections comprised 20.3% of the total surveyed. The sample population, by base and rank, is representative of the the actual distribution of personnel assigned to the wings. The authors compared the number of assigned personnel by rank and base as of 31 January 1984 against the actual numbers responding (Table VII).

TABLE VI

Descriptive Statistics for Section I Background

Q 1 Your age is:

	FREQUENCY	# VALID CASES	MEAN	MODE
1. less than 20 years	6.2	341	2.475	2
2. 20 - 25 years	60.7			
3. 26 - 30 years	17.6			
4. 31 - 35 years	11.1			
5. 36 - 40 years	3.8			
6. more than 40 years	0.6			

Q 2 Your highest education level obtained so far:

	FREQUENCY	# VALID CASES	MEAN	MODE
1. non-high school graduate	0.0	341	2.683	3
2. h. s. graduate/equivalent	41.9			
3. some college work completed	49.6			
4. associates degree	6.7			
5. bachelors degree	1.8			
6. some graduate work	0.0			
7. master's degree	0.0			

Q 3 Your sex is:

	FREQUENCY	# VALID CASES	MEAN	MODE
1. male	95.9	341	1.041	1
2. female	4.1			

Q 4 Your current skill level is:

	FREQUENCY	# VALID CASES	MEAN	MODE
1. 3-level, in TTB	2.1	341	3.276	3
2. 3-level, in field	1.5			
3. 5-level	66.0			
4. 7-level	27.9			
5. 9-level	2.6			

Q 5 Indicate any of the AFSC's listed below that you have held in your Air Force career.

	FREQUENCY	# VALID CASES	MEAN	MODE
1. 541XX	33.5	340	4.124	6
2. 542XX	2.9			
3. 543XX	0.9			
4. 545XX	2.1			
5. 552XX	1.5			
6. n/a	59.1			

TABLE VI (continued)

Descriptive Statistics for Section I Background

Q 6 If you held one of the above AFSCs how long did you have it before you cross-trained to the AFS 445X0G career field?

	FREQUENCY	# VALID CASES	MEAN	MODE
1. less than 1 year	1.8	339	5.029	6
2. 1 - 3 years	15.3			
3. 4 - 5 years	6.8			
4. 6 - 10 years	2.7			
5. more than 10 years	1.2			
6. n/a	72.3			

Q 7 The total time you have worked in the Minuteman system since originally entering Team Training Branch is:

	FREQUENCY	# VALID CASES	MEAN	MODE
1. less than 1 year	18.0	339	2.920	3
2. 1 yr but less than 2 yrs	19.8			
3. 2 yrs but less than 4 yrs	28.0			
4. 4 yrs but less than 8 yrs	22.7			
5. 8 yrs but less than 12 yrs	9.4			
6. 12 years or more	2.1			

Q 8 Your rank is:

	FREQUENCY	# VALID CASE	MEAN	MODE
1. Amn or A1C	42.5	341	2.651	1
2. SrA	7.9			
3. Sgt	11.1			
4. SSgt	23.2			
5. TSgt	11.4			
6. MSgt	3.2			
7. SMSgt or CMSgt	0.6			

Q 9 You are currently serving as a:

	FREQUENCY	# VALID CASES	MEAN	MODE
1. team member	42.2	339	2.434	1
2. team chief	21.5			
3. shop supervisor	11.5			
4. branch/squadron supervisor	0.9			
5. staff member	23.3			

TABLE VI (continued)

Descriptive Statistics for Section I Background

Q 10 Indicate the functional area to which you are presently assigned:

	FREQUENCY	# VALID CASES	MEAN	MODE
1. Facilities Maintenance Team Branch	33.4	341	2.229	2
2. Periodic Maintenance Team Branch	37.8			
3. Training Control Division	2.3			
4. Quality Control Division	9.7			
5. Maintenance Control Division	2.3			
6. Other	4.4			

Q 11 To which base are you assigned:

	FREQUENCY	# VALID CASES	MEAN	MODE
1. Ellsworth AFB	7.6	341	3.956	4
2. F.E. Warren AFB	16.1			
3. Grand Forks AFB	16.7			
4. Malmstrom AFB	22.9			
5. Minot AFB	13.2			
6. Whiteman AFB	16.1			
7. Vandenberg AFB	7.3			

TABLE VII

Comparison of Assigned versus Number Survey Respondents (SR) by Rank and Base

COUNT / ROW PCT / COL PCT / TOT PCT	A1C/AMN		SRA/SGT		SSGT		TSGT		MSGT/SMSGT/CMSGT		ROW TOTAL	
	ASG	SR	ASG	SR	ASG	SR	ASG	SR	ASG	SR	ASG	SR
	48	10	18	9	22	6	6	1	7	0	101	26
ELLSWORTH	47.5	38.5	17.8	34.6	21.8	23.1	5.9	3.8	6.9	0	14.3	7.6
	16.0	6.9	12.8	13.8	13.8	7.6	8.6	2.6	18.9	0		
	6.8	2.9	2.5	2.6	3.1	1.8	3.1	0.3	1.0	0		
	57	32	26	11	24	8	12	3	3	1	122	55
F.E.	46.7	58.2	21.3	20.0	19.7	14.5	9.8	5.5	2.5	1.8	17.3	16.1
WARREN	19.1	22.1	18.4	40.0	15.1	10.1	17.1	7.7	8.1	7.7		
	8.1	9.4	3.7	3.3	3.4	2.3	1.7	0.9	0.4	0.3		
	43	26	20	9	21	13	11	8	8	1	103	57
GRAND	41.7	45.6	19.4	15.8	20.4	22.8	10.7	14.0	7.8	1.8	14.6	16.7
FORKS	14.3	17.9	14.2	13.8	13.2	16.5	15.7	20.5	21.6	7.7		
	6.1	7.6	2.8	2.7	3.0	3.8	1.6	2.3	1.1	0.3		
	60	31	30	15	26	17	11	10	6	5	133	78
MALMSTROM	45.1	39.7	22.5	19.2	19.5	21.8	8.3	12.8	4.5	6.4	18.8	22.9
	16.1	21.4	21.3	23.1	16.4	21.5	15.7	25.6	16.2	38.5		
	8.5	9.1	4.2	4.4	3.7	5.0	1.6	2.9	0.9	1.5		
	48	23	18	8	23	9	13	4	13	1	105	45
MINOT	45.7	51.1	17.1	17.8	21.9	20.0	12.4	8.9	12.4	2.2	14.9	13.2
	20.1	15.9	12.8	12.3	14.5	11.4	18.6	10.3	18.6	7.7		
	6.8	6.7	2.5	2.6	3.3	2.6	1.8	1.2	1.8	.3		
	40	23	22	11	22	12	11	9	4	0	99	55
WHITEMAN	40.4	41.8	22.2	20.0	22.2	21.8	11.1	16.4	4.0	0	14.0	16.1
	13.4	15.9	13.8	16.9	13.8	15.2	15.7	23.1	8.1	0		
	5.7	6.7	3.1	3.3	3.1	3.5	1.6	2.6	0.6	0		
	3	0	7	2	21	14	6	4	6	5	43	25
VANDEN-	7.0	0	16.3	8.0	48.8	56.0	14.0	16.0	14.0	20.0	6.1	7.3
BERG	1.0	0	5.0	3.1	13.2	17.7	8.6	10.3	16.2	38.5		
	0.4	0	2.3	0.6	3.0	4.1	0.1	1.2	0.1	1.5		
COLUMN TOTAL	299	145	141	65	159	79	70	39	37	13	706	341
	42.4	42.5	20.0	20.0	22.5	23.2	9.9	11.4	5.2	3.8		

* ASG = personnel assigned as of 31 January 1984, according to HQ SAC/LGB
SR = personnel actually responding to the survey

Section II Work Attitudes. In general, the work attitude of the majority of respondents is positive. (Tables VIII a & b) However, there is a relatively large percentage that expressed negative feelings towards their work. Of those responding 38.4% find their work so-so to very dull (Q12), and a full 41.9% are anywhere from indifferent about their to job to hating it (Q13). Although research does not support an effect of work attitude on job performance, such large percentages of negative and ambivalent feelings toward the job is significant because it may indicate a morale problem.

As the descriptive statistics indicate 72% of the technicians feel that they have accomplished something at the end of a dispatch (Q15), and 66.5% are satisfied with that sense of accomplishment (Q16). Overwhelmingly, 81.2% of the respondents felt their job to be significant and important in relationship to all other maintenance jobs (Q17). This was a key job characteristic (task significance) in the Hackman and Oldham model discussed earlier in Chapter II.

Questions 18 through 21 dealt with respondent attitudes toward their supervisors. In general, most respondents are satisfied with the support they obtain from their supervisors and the quality of the supervisors (Q20 & Q21). However, there was a significant minority (37.7%) who were either neutral or dissatisfied with the quality of their supervisors. This is well over one-third of the respondent population and it may indicate a potential problem in the future. Further analysis was conducted to determine whether a population sub-group accounted for a majority of negative responses.

Crosstabulations with rank, job position, functional area, and base were run and a Student t-test performed for those sub-groups appearing

TABLE VIIIa

Descriptive Statistics for Section II Work Attitudes

Q 12 How do you find your job?

	FREQUENCY	# VALID CASES	MEAN	MODE	SKEWNESS	KURTOSIS
1. very dull	4.1	341	4.833	6	-0.708	0.131
2. dull	3.8					
3. somewhat dull	7.6					
4. so-so	22.9					
5. somewhat interesting	22.3					
6. interesting	29.3					
7. very interesting	10.0					

Q 13 Choose one of the following statements which best tells how well you like your job.

	FREQUENCY	# VALID CASES	MEAN	MODE	SKEWNESS	KURTOSIS
1. I hate it	5.0	341	4.402	5	-0.665	0.323
2. I dislike it	7.0					
3. I don't like it	8.8					
4. I am indifferent to it	21.1					
5. I like it	43.4					
6. I am enthusiastic about it	9.4					
7. I love it	5.3					

Q 14 How much do you use your AFS 445X0G training in your present job?

	FREQUENCY	# VALID CASES	MEAN	MODE	SKEWNESS	KURTOSIS
1. not at all	2.9	339	5.012	7	-0.469	-0.808
2. very little	7.7					
3. little	8.8					
4. fair amount	20.6					
5. quite a bit	14.7					
6. a lot	15.9					
7. almost all the time	29.2					

Q 15 In general, at the end a maintenance dispatch I often feel I have accomplished *something.*

	FREQUENCY	# VALID CASES	MEAN	MODE	SKEWNESS	KURTOSIS
1. strongly disagree	3.2	340	5.153	6	-1.019	0.490
2. disagree	4.4					
3. slightly disagree	6.2					
4. neither disagree nor agree	14.1					
5. slightly agree	18.2					
6. agree	39.7					
7. strongly agree	14.1					

TABLE VIIIa (continued)

Descriptive Statistics for Section II Work Attitudes

Q 16 How satisfied are you with the sense of accomplishment you gain from your work?

	FREQUENCY	# VALID CASES	MEAN	MODE	SKEWNESS	KURTOSIS
1. extremely dissatisfied	3.5	340	4.856	6	-0.766	-0.269
2. dissatisfied	8.5					
3. slightly dissatisfied	7.5					
4. neither satisfied nor dissatisfied	13.5					
5. slightly satisfied	22.4					
6. satisfied	33.5					
7. extremely satisfied	10.6					

TABLE VIIIb

Descriptive Statistics for Section II Work Attitudes

Q 17 The job I do is very significant and important in relationship to all other maintenance jobs.

Q 18 In general, my shop and branch supervisors care about the quality of the work I do.

Q 19 In general, my shop and branch supervisors encourage me to constantly improve the quality of my work.

Q 20 In general, my shop and branch supervisors provide adequate support for me to accomplish my job. (e.g. solving dispatch problems, supporting my decisions, etc)

Q 21 In general, I am happy with the quality of supervision my supervisors provide.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7
17	5.569	6	-1.305	1.179	341	2.6	4.4	3.8	7.9	16.1	34.0	31.1
18	5.622	6	-1.449	1.690	341	2.6	3.5	3.5	8.8	11.1	41.6	28.7
19	5.129	6	-0.842	0.104	340	2.6	5.6	5.3	17.6	17.6	33.8	17.4
20	4.774	6	-0.673	-0.663	340	7.1	8.2	9.1	14.1	13.2	33.8	14.4
21	4.748	6	-0.744	-0.440	341	7.6	7.0	7.6	15.5	16.1	35.2	10.6

TABLE IX

Student t-test Results for PMT versus Others*

QUESTION	MEAN	STD DEV	T VALUE	DEG OF FREE	2-TAIL PROBABILITY
Q 12 Job Attitude					
PMT	3.1240	1.596	-7.40	339	0.000
Others	4.2642	1.230			
Q 13 Like the Job					
PMT	2.8605	1.525	-5.86	339	0.000
Others	3.7311	1.200			
Q 16 Sat of Accomplishment					
PMT	3.2031	1.750	-6.19	338	0.000
OTHERS	4.2500	1.345			
Q 20 Support of Supervisors					
PMT	3.2188	1.865	-4.53	338	0.000
OTHERS	4.1085	1.681			
Q 21 Quality of Supervision					
PMT	3.4109	1.735	-2.80	339	0.000
OTHERS	3.9528	1.730			

* # of PMT cases = 128 or 129
# of OTHER cases = 212

to have lower means. Of the sub-groups tested the only one to show a statistically different mean from the rest was the Periodic Maintenance Team (PMT) section, and only for survey questions 12, 13, 16, 20, and 21 crosstabulated against question 10, functional area. (Table IX) In all cases PMT was more negative in their responses.

In sum, the majority of respondents are positive in their attitudes toward their work, however, a significant minority are not satisfied with their jobs. While most respondents are satisfied with the supervisory support they receive there is still a large minority who are not satisfied with the quality of the supervisors. An important finding was that respondents do feel their work is significant. Finally,

technicians within PMT appear to have more negative attitudes in general than other facilities maintenance technicians.

Section IV Personnel Proficiency Perceptions. This section of the survey is probably the most important one in light of the research questions. Table X contains the descriptive statistics for this section. In general, the respondents feel competent in the performance of their job with 87.8% of them responding positively (Q29). Additionally, 93% of all respondents feel good about the quality of their work (Q34). Questions pertaining to feelings of competency in the power production system (Q30) or environmental control system (Q31) were more neutral. Crosstabulation of the two questions reveals that a majority of the respondents do not feel more competent in one area then than the other (27.5%). (Table XI) For those indicating a preference the majority show a positive feeling for one and a negative feeling for the other (42.3%), as opposed to a mere 14.1% who expressed either all negative or all positive feelings. Additionally, there is a slightly larger percentage that feel more competent in power production than environmental control system work.

The respondents generally agree their shop supervisors are capable of providing them with technical assistance (Q39 & Q40); however, a large minority are either neutral or disagree (44.5% relating to power production tasks and 46.3% relating to ECS tasks). Supervisor feedback on technician job performance (Q43) shows that 60% of the respondents receive feedback only sometimes to never, with 20% in the category never to almost never receiving feedback. Only 19.3% receive feedback always or almost always. Task feedback was an important job characteristics in the job characteristics models in Chapter II.

TABLE X

Descriptive Statistics for Section IV Personnel Proficiency

Q 29 In general, I feel competent in the performance of my job.

Q 30 In general, I feel more competent in the performance of power production tasks than environmental control tasks.

Q 31 In general, I feel more competent in the performance of environmental control tasks than power production tasks.

Q 32 Evaluations performed by Quality Control accurately measure how well I do my job.

Q 33 Evaluations performed by the 3901st SMES accurately measure how well I do my job.

Q 34 I feel good about the quality of the work I perform.

Q 35 When I am required to perform power production tasks, the work often must be reaccomplished because I did not understand the system sufficiently to properly identify the problem and/or repair it.

Q 36 When I am required to perform environmental control system tasks, the work often must be reaccomplished because I did not understand the system sufficiently to properly identify the problem and/or repair it.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7
29	5.901	6	-1.713	3.183	303	0.7	2.6	2.3	6.6	8.3	47.2	32.3
30	4.404	4	-0.117	-0.869	302	7.9	7.6	11.9	32.8	6.6	14.6	18.5
31	4.113	4	0.002	-0.573	302	8.9	8.9	11.6	38.4	8.6	11.6	11.9
32	3.555	2	0.203	-1.141	301	17.3	18.3	15.0	17.3	11.3	15.3	5.6
33	4.010	4	-0.091	-1.136	301	13.3	13.3	12.0	19.9	13.6	17.9	10.0
34	6.093	6	-2.147	6.835	301	0.7	1.3	0.3	4.7	6.6	51.5	34.9
35	1.934	1	1.949	4.307	301	47.8	32.9	6.6	8.0	2.0	1.0	1.3
36	1.997	1	1.728	3.370	301	42.9	35.5	9.0	8.3	1.7	1.3	1.3

TABLE X (continued)

Descriptive Statistics for Section IV Personnel Proficiency

Q 37 When I am required to perform certain power production system tasks, although I was trained, I lack confidence because I perform the tasks so infrequently.

Q 38 When I am required to perform certain environmental control system tasks, although I was trained, I lack confidence because I perform the tasks so infrequently.

Q 39 In general, my shop supervisor is capable of providing technical assistance in power production tasks.

Q 40 In general, my shop supervisor is capable of providing technical assistance in environmental control system tasks.

1. strongly disagree 3. slightly disagree 5. slightly agree 7. strongly agree
2. disagree 4. neither disagree nor agree 6. agree

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7
37	3.010	1	0.546	-0.916	302	26.5	24.2	11.6	12.9	12.6	8.9	3.3
38	3.027	1	0.502	-0.959	301	28.6	21.3	10.6	13.0	15.9	6.3	4.3
39	4.525	6	-0.574	-0.763	301	10.3	8.6	6.0	19.6	15.3	29.2	11.0
40	4.483	6	-0.529	-0.767	300	10.0	8.3	7.3	20.7	15.3	28.0	10.3

Q 41 When I perform troubleshooting, checkout and/or repair on the power production system I require outside assistance.

Q 42 When I perform troubleshooting, checkout and/or repair on the environmental control system I require outside assistance

Q 43 In general, my supervisors provide feedback on my job performance.

1. never 3. seldom 5. usually 7. always
2. almost never 4. sometimes 6. almost always

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7
41	2.753	2	0.994	1.020	300	16.3	35.7	20.3	19.3	3.7	1.7	3.0
42	2.702	2	0.940	0.943	305	16.1	36.1	22.3	17.0	4.6	1.6	2.0
43	4.026	4	-0.172	-0.677	305	9.2	10.8	13.8	26.2	20.7	13.1	6.2

TABLE XI

Crosstabulation Results of Questions 30 and 31

	Q31 Competent in ECS						
COUNT / TOT PCT							ROW
Q30 Competent in Power Production	Strgly Disagree	Disagree	Sligtly Disagree	Neither	Sligtly Agree	Agree	Strgly Agree	TOTAL
Strongly Disagree	10	1	0	0	0	1	12	24
	3.3	.3	0	0	0	.3	4.0	7.9
Disagree	0	6	1	0	0	11	5	23
	0	2.0	.3	0	0	3.6	1.7	7.6
Slightly Disagree	0	1	2	1	12	9	11	36
	0	.3	.7	.3	4.0	3.0	3.6	11.9
Neither	1	0	0	83	7	4	4	99
	.3	0	0	27.5	2.3	1.3	1.3	32.8
Slightly Agree	0	0	6	8	2	2	2	20
	0	0	2.0	2.6	.7	.7	.7	6.6
Agree	4	8	13	11	2	6	0	44
	1.3	2.6	4.3	3.6	.7	2.0	0	14.6
Strongly Agree	12	11	13	13	3	2	2	56
	4.0	3.6	4.3	4.3	1.0	.7	.7	18.5
COLUMN TOTAL	27	27	35	116	26	35	36	302
	8.9	8.9	11.6	38.4	8.6	11.6	11.9	100.0

Two questions in this section were asked pertaining to personnel proficiency evaluations conducted by the local Quality Control function and the 3901st SMES (Q32 & Q33). The descriptive statistics indicate the respondents are more neutral in attitude toward the 3901st SMES than the local Quality Control function. The distribution on 3901st SMES is only slightly skewed positive and the mode is "neither agree or disagree". On the other, the distribution for the local quality control is distinctly negative with a mode at the disagree response and skewed toward the negative side. A standard normal test was conducted

between the two means using a one-tailed test with a 95% confidence level. The hypotheses are:

H_0: The two means are equal.

H_a: The mean for attitude toward local quality control is less than the mean for attitude toward 3901st SMES

$$Z_{.05} = 1.645 \qquad Z_{ts} = 2.965$$

Since the test statistic, Z_{ts}, is greater than $Z_{.05}$ the null hypothesis (H_0) is rejected, and the mean for attitude toward local quality control is considered statistically less than that for 3901st SMES. While not validating the accuracy of the 3901st SMES evaluation system, this does indicate that at least in the minds of the respondents the 3901st SMES evaluations more accurately measure their personnel proficiency.

Crosstabulation with rank, years experience, functional area, and job position indicate the older, more experienced the respondent is the more negative he feels regarding the adequacy of the 3901st SMES evaluation. This finding is discussed further under Section VII In Your Opinion.

In sum, the respondents feel competent in the performance of their job. However, they do feel slightly more competent on power production tasks than environmental control tasks. There is a large minority who do not feel their supervisors can provide technical assistance in one area or the other. A large majority of technicians are not getting an adequate amount of feedback from their supervisors which would hinder their ability to correctly access their own performances.

Section V Training Perceptions. The responses to the questions in this section are interesting. (Table XII) Opinions on the usefulness of their training (Q44) are almost equally divided with 48% agreeing that

TABLE XII

Descriptive Statistics for Section V Training Perceptions

Q 44 In general, my training has prepared me to do all the tasks I am required to do.

Q 45 My training on the environmental control system (ECS) has prepared me to do all the ECS tasks required of me.

Q 46 My training in troubleshooting the environmental control system has given me a good understanding how to find ECS related problems.

Q 47 My training on the power production system has prepared me to do all the power production tasks required of me.

Q 48 My training in troubleshooting the power production system has given me a good understanding of how to find power production related problems.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7
44	4.050	6	-0.173	-1.207	300	11.3	13.7	17.0	10.3	19.3	22.0	6.7
45	4.158	6	-0.106	-1.062	303	6.3	13.2	20.1	14.9	17.2	21.1	7.3
46	4.707	6	-0.751	-0.360	304	5.3	7.9	8.9	15.8	20.1	35.2	6.9
47	4.342	6	-0.338	-1.048	304	5.0	12.5	14.8	13.5	17.4	27.3	7.6
48	4.653	6	-0.643	-0.462	303	5.0	8.3	10.2	15.8	22.4	30.4	7.9

TABLE XII (continued)

Descriptive Statistics for Section V Training Perceptions

Q 49 My training was too long and covered too many areas for me to retain all I was taught.

Q 50 My training would have been more beneficial if I had only been required to learn either the power production system or the environmental control system, but not both.

Q 51 I feel the material I learned in my Career Development Course (CDC) has helped improve my maintenance proficiency.

Q 52 I feel that upgrading technicians to the 5 level following completion of the CDC gives them enough time to acquired the knowledge and skill expected of a 5 level.

Q 53 I would not change about my training.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7
49	3.576	2	0.307	-0.971	304	12.5	25.0	10.9	21.4	12.5	9.9	7.9
50	3.768	1	0.128	-1.408	302	21.9	17.9	4.6	17.5	8.6	14.6	14.6
51	3.328	4	0.262	-0.924	302	17.2	21.9	12.3	23.8	12.3	9.6	3.0
52	3.624	4	0.102	-1.068	303	13.5	17.5	15.5	24.1	7.9	18.8	2.6
53	2.595	1	1.083	0.764	301	29.2	26.2	21.6	12.3	3.7	3.3	3.7

it prepared them to do their job and 42% disagreeing. Ten percent are not sure if it prepared them to do their job. With this ten percent, over half of the respondents do not feel their training prepared them to do all the tasks they are required to do. When asked about training on the specific systems (Q45 thru Q48) there is more doubt expressed about the preperation for environmental control system tasks then for power production tasks. Furthermore, training on troubleshooting procedures for both systems (Q46 & Q48) is more favorably regarded than general task training (Q45 & Q47).

Crosstabulation of these questions against rank, job position, functional area, and base were conducted and Student t-tests run for those sub-groups that might have been different. Only one sub-group, on one question, showed a mean unequal to the group as a whole to a statistically significant degree. Periodic Maintenance Team members more strongly disagree with the statement that their training on trouble shooting ECS tasks (Q46) was adequate.

When respondents were asked about the quality of the current Career Development Course (CDC) (Q51) and the policy for upgrading to the five skill level based on completion of the CDC (Q52) the response was more toward "disagree." Over seventy-five percent could not agree with the statement that their CDC had helped improve their maintenance proficiency. Forty-six percent disagreed with the statement that upgrading technicians to the five skill level following completion of the CDC was sufficient time to acquire the required knowledge and skill of a five level. This is significant considering completion of the CDC is a requirement for upgrading to five skill level.

A large majority of respondents (77%) indicate they would change

some aspect of their training (Q53). Fifty-two percent of the respondents were either unsure or agreed with the statement that their training was too long and covered to many areas (Q49). Furthermore, a large minority (37.8%) of respondents feel their training would have been more beneficial if they had been trained in either power production or ECS, but not both (Q50).

In sum, an alarmingly high minority of the respondents have doubts about the value of the training they receive. There are more doubts expressed about ECS training than power production training, yet respondents feel more favorable toward their training in troubleshooting procedures in both systems. An overwhelming majority of respondents would change something about the training program, with a significant minority feeling the training was too long and covered to much material. Finally, there is doubt expressed about the value of the CDC course and whether completing it is adequate justification for upgrading a technician to the five skill level.

Section VI Supervisors Perceptions. When the gross results from this section were first analyzed it appeared that individuals who were not supervisors, as defined on page 2 of the survey booklet, had responded to this section. This was confirmed by crosstabulation with question 9 dealing with current job position. Therefore, the descriptive statistics were obtained by filtering the original responses using the SPSS "select if" statement. Only those respondents who responded to question 9 as shop, branch, or squadron supervisors, or with the rank of technical sergeant for staff positions became part of the analysis. Table XIII contains the descriptive statistics for this group.

TABLE XIII

Descriptive Statistics for Section VI Supervisors Perceptions

Q 54 The maintenance performed by the technicians I supervise on the power production system is of ...

Q 55 The maintenance performed by the technicians I supervise on the environmental control system is of ...

1. very poor quality
2. poor quality
3. below average quality
4. average
5. above average quality
6. high quality
7. very high quality

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7
54	4.857	4	-0.142	-0.329	49	0.0	4.1	4.1	36.7	20.4	26.5	8.2
55	4.837	4	-0.282	-0.042	49	0.0	6.1	2.0	34.7	24.5	24.5	8.2

Q 56 The technicians I know who were trained prior to the creation of the 445XOG career field are more knowledgeable than the technicians today.

Q 57 I feel that I was more knowledgeable as a technician than the people I supervise today, with the same number of years experience.

Q 58 I have a group of technicians that I consider to be more knowledgeable in power production, and as a result, I dispatch them to solve the power production system related problems most of the time.

Q 59 I have a group of technicians that I consider to be more knowledgeable in environmental control, and as a result, I dispatch them to solve the environmental control system problems most of the time.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree
8. no knowledge prior to consolidation

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7	8
56	4.680	4	-0.067	-1.092	50	8.0	10.0	10.0	26.0	8.0	8.0	22.0	8.0
57	4.760	6	-0.453	-0.498	50	4.0	6.0	12.0	20.0	20.0	22.0	16.0	0.0
58	4.020	4	0.191	-0.814	49	4.1	24.5	2.0	38.8	8.2	10.2	12.2	0.0
59	4.000	4	0.159	-0.121	49	6.1	22.4	4.1	36.7	6.1	12.2	12.2	0.0

TABLE XIII (continued)

Descriptive Statistics for Section VI Supervisors Perceptions

Q 60 I feel I have adequate task coverage in the power production system tasks.

Q 61 I feel I have adequate task coverage in the environmental control system tasks.

Q 62 Personnel proficiency has declined since the AFSC consolidation occured.

Q 63 The condition of the power production hardware maintained by Facility Maintenance Technicians (AFS 445X0G) has declined since the AFSC consolidation occured, disregarding the age of the weapon system.

Q 64 The condition of the environmental control hardware maintained by Facility Maintenance Technicians (AFS 445X0G) has declined since the AFSC consolidation occured, disregarding the age of the weapon system.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree
8. no knowledge prior to consolidation

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7	8
60	5.438	6	-0.861	-0.121	48	0.0	6.3	2.1	22.9	4.2	39.6	25.0	0.0
61	5.551	6	-0.898	0.142	49	0.0	4.1	2.0	20.4	8.2	38.8	26.5	0.0
62	4.308	4	-0.170	-0.936	50	8.0	10.0	8.0	22.0	8.0	16.0	20.0	6.0
63	3.290	2	0.237	-1.248	50	12.0	28.0	4.0	16.0	10.0	16.0	10.0	4.0
64	3.780	2	0.554	-0.883	50	12.0	34.0	4.0	14.0	10.0	10.0	10.0	4.0

Q 65 I feel that consolidation of the career fields has had the following effect on technician proficiency levels.

1. greatly decreased it
2. decreased it
3. slightly decreased it
4. had no effect
5. slightly increased it
6. increased it
7. greatly increased it

QUESTION	MEAN	MODE	SKEWNESS	KURTOSIS	# VALID CASES	PERCENT FREQUENCY RESPONSE 1	2	3	4	5	6	7
65	3.367	4	0.064	-0.987	49	20.4	12.2	18.4	20.4	18.4	8.2	2.0

In general, supervisors feel the quality of their technician's work is good (Q54 & Q55). For the power production system 55.1% felt the quality was above average, while only 8.2% felt it was below average. For the environmental control system 57.2% felt the quality was above average, while 8.1% felt it was below average.

For the most part supervisors feel that technicians trained prior to the creation of the AFS 445XOG are more knowledgeable than those trained since then (Q56 - 38%). They also feel when they were technicians, with the same number of years experience as those they supervise today, they were more knowledgable (Q57 - 58.0%).

Four questions addressed the supervisors specialized use of technicians to obtain adequate task coverage (Q58 thru Q61). These questions seem to indicate some specialization may be occuring with both power production and ECS tasks. Table XIV shows that one third of the supervisors do have a group of technicians they use most often to solve either power production or ECS system related problems. Moreover, most supervisors indicate they have adequate task coverage in both power production and ECS systems with only 8.4% and 6.1% disagreeing to the questions, respectively. However, it is not possible to determine whether this adequacy of task coverage is dependent upon the implied specialized use of technicians.

When asked in questions 62 and 65 about the effects of AFS consolidation on personnel proficiency 44.0% and 51% respectively agreed with the statement that personnel proficiency had declined since consolidation. There was, however, a large minority percentage of respondents to Q65 who felt the consolidation had no effect (20.4%) or that it had actually increased proficiency (28.6%).

TABLE XIV

Supervisors Use of and Coverage by Technicians

QUESTION	FREQUENCY		
	DISAGREE	NEUTRAL	AGREE
58 (specialized power production)	30.6	38.8	30.6
59 (specialized ECS)	32.6	36.7	30.5
60 (adequate power production coverage)	8.4	22.9	68.8
61 (adequate ECS coverage)	6.1	20.4	73.5

Supervisors were asked their feelings on the effects of consolidation on the power production (Q63) and environmental control systems hardware (Q64). While 44.0% disagree that power production hardware condition has declined, there were still 36.0% who agree and another 16.0% who are neutral. Fifty percent disagree on the negative effect of consolidation on the environmental control system, but 30.0% agree and 14.0% are neutral. It also appears there is a feeling the power production hardware has been more negatively affected by the consolidation than the ECS hardware.

In sum, while supervisors feel good about the quality of the facility maintenance technicians' work they still feel it is not as good as when they were technicians themselves. Supervisors appear to be using their technicians as specialists which seems to be substantiated by the perceptions of competency in one area over another as expressed by the technicians in Section IV Personnel Perceptions. Finally, a majority of the supervisors feel the consolidation has had a negative effect on personnel proficiency and on the hardware.

Section VII In Your Opinion. Respondents were given the opportunity to express their opinions and ideas on various topics related to the research questions. Of the 341 total respondents 279

responded (81.8%) to these questions. Table XV contains the response frequencies for the gross categories. These categories were selected by the authors based on an initial evaluation of the comments.

TABLE XV

Descriptive Statistics for Section VII In Your Opinion*

Q 66 Do you think the 3901st Strategic Missile Evaluation Squadron evaluations are an adequate evaluation of your personal job proficiency?

	FREQUENCY	# VALID CASES
Never evaluated	10.9	255
No, SMES not adequate evaluation	52.2	
Yes, SMES is an adequate evaluation	38.0	

Q 67 If you perceive that a problem exists with 445XOG personnel proficiency levels, what would you consider the main problem to be?

	FREQUENCY	# VALID CASES
Lack of experience	33.9	245
Problems with training	31.4	
System too complex or tasks too diverse	17.6	
STS too large	21.6	
Poor attitudes on part of technicians	7.8	
Too little apprentice time	7.8	
Other	13.5	
There is not a problem	3.7	

Q 68 If you perceive that a problem exists with the condition of the hardware, what would you consider the main reason to be?

	FREQUENCY	# VALID CASES
Aging weapon system	73.6	242
Poor management practices	11.2	
Inexperienced technicians/problems with personnel proficiency	9.9	
Hardware/Equipment/Tech data inadequacies	17.8	
There is no problem with the system	4.1	
Poor attitudes on part of technicians	9.5	
Other	6.6	

* Frequency of response is the percentage of those individuals who responded, therefore the total percentage will be greater than 100% since some respondents gave two responses.

TABLE XV (continued)

Descriptive Statistics for Section VII In Your Opinion

Q 69 How would you improve your training program to increase the overall level of personnel proficiency?

	FREQUENCY	# VALID CASES
Lengthen the training program	16.0	238
Train either power production or ECS	14.3	
Increase intensity/depth of training	13.0	
Increase hands-on training program	11.3	
Change the TTB program/instructors	31.5	
Other	30.3	
Do not change the program	7.6	

Q 70 If you could manage the way your AFS 445X0G career field is structured or managed what would you want to see done.

	FREQUENCY	# VALID CASES
Improve management practices	36.9	206
Do not change the career field	5.8	
Return to specialists like before	23.3	
Change the training program	15.0	
Do not allow cross-trainees	7.3	
Improve the overall work environment	28.6	
Improve manning conditions at all levels	6.3	
Other	7.8	

Question 66, relating to 3901st SMES evaluations, is the only question having one distinct response per individual respondent (yes, no, or neither). The prevailing attitude among the respondents was that 3901st SMES was not an adequate evaluation of their personal proficiency (52.2%). The reason given most often was that the 3901st SMES evaluation was too infrequent, and that one week out of the year was not a true indicator of their overall performance. They felt too many intervening variables impinged on the accuracy of the evaluations (e.g. inadequate experience with the task, weather, evaluator bias). Crosstabulations were conducted against job position, rank, functional area, time in Minuteman, and base, and the results are found in (Table XVI).

Team chiefs and team members were more likely to be evenly split between yes and no responses, yet supervisors and staff members were more critical of the evaluation process. Similarly, the younger individuals, in both rank and experience, were more evenly divided on how accurately 3901st SMES assessed their performance, whereas the older the individuals were the more likely they were to be negative. This is surprising when it is considered that those undergoing the evaluations are more positive then those who are not. As the individuals become more removed from actual personnel proficiency evaluations they become more negative (training and quality control personnel undergo evaluations primarily in the performance of their duties as trainers and evaluators). A crosstabulation with question 33, the Likert scale question on 3901st SMES measure of job performance, showed respondents were reasonably consistent in their response between the two questions (Table XVI).

Question 67 dealt with perceived problems in personnel proficiency. Although task complexity, task diversity, and STS size were not as frequent responses individually, the cumulative value of these responses is 39.2%, which is a large minority of the group. Additionally, many of the comments on training alluded to these three responses while not specifically addressing them. Many of the more detailed responses talked about the need for more in-depth, longer training programs. Crosstabulations with job position, functional area, years in Minuteman, base, and rank did not indicate particular sub-groups were responding more frequently to any one category.

Question 68 dealt with problems with hardware conditions and was designed as a follow-on to question 67. It did not reveal, as the

TABLE XVI

Crosstabulation Results for Question 66

	Not evaluated	Not adequate	Adequate	Total
Team members	20.2	39.3	40.4	89
Team chiefs	7.4	46.3	46.3	54
Shop supervisor	3.1	75.0	21.9	32
Branch/Squadron Supr	0.0	66.7	33.1	3
Staff member	1.6	64.5	30.6	62
FMT	6.4	48.7	44.9	78
PMT	20.0	43.5	36.5	85
Training	3.0	72.7	24.2	33
Quality Control	0.0	74.1	25.9	27
Maintenance Control	14.3	42.9	42.9	7
A1C	18.8	39.1	42.4	92
SrA	5.6	50.0	44.8	18
Sgt	0.0	38.5	61.5	26
SSgt	4.9	68.9	26.2	61
TSgt	6.3	65.6	21.9	32
MSgt/SMSgt/CMSgt	1.6	72.7	18.8	11
< 1 yr	36.4	22.7	40.9	44
1 but < 2 yr	12.2	46.3	41.5	41
2 but < 4 yrs	1.5	56.9	41.5	65
4 but < 8 yrs	1.8	68.4	28.1	57
8 but < 12 yrs	3.8	61.5	30.8	26
> 12 yrs	0.0	71.4	28.6	7
Q33 Evaluations performed by 3901st SMES accurately measure how well I do my job.				
Disagree	3.4	83.9	12.6	87
Neither disagree/agree	30.8	38.5	30.8	39
Agree	9.6	22.9	67.5	83

authors expected, that respondents felt personnel proficiency problems were contributing to problems with the hardware. Inexperience and technician attitude individually represented less than ten percent of the respondents. The majority of respondents (73.6%) felt the primary problem with the system was the age of the weapon system. The next most frequent response category dealt with inadequacies in the hardware design, modifications to the hardware, and the quality of the

replacement parts. This comment indirectly reflects the problem with the age of the hardware since parts are harder to obtain, replacements are not always made by the original manufacturer, and modifications try to incorporate 1980 technology with 1950 designs. Crosstabulations with rank, base, functional area, job position, and time in Minuteman did not reveal a sub-group responding more frequently to a particular response.

Question 69, which asked the respondents how they would improve their training program, resulted in the most diverse responses, as evidenced by the large Other category (30.3%). However, disregarding this category, most respondents recommended changing the Team Training Branch (TTB) program in some way. Crosstabulation with functional area shows respondents from the PMT section responded in this category more frequently (30.9%) than any other sub-group. The other sub-groups were evenly dispersed among all the categories. The predominant recommendation regarding TTB training was to eliminate it or the basic technical training program at Chanute AFB. Additionally, respondents often commented on the lack of quality and low experience level of the instructors assigned to TTB. The number of responses indicating the desire to specialize the training between ECS and power production was not as high as the authors had anticipated (14.3%).

Question 70 dealt with recommendations on structural and managerial changes to the career field. It appears to have been interpreted by some respondents differently than the authors intended. Crosstabulation of the results indicate team members commented more on the day-to-day work environment and management practices affecting them than any other sub-group. Team chiefs, supervisors, and staff members expressed

comments of a broader viewpoint, related more to the external structure of the career field (specialization, training, manning, etc). Within this group it was team chiefs and shop supervisors, those dealing with the actual maintenance requirements, who most frequently recommended specializing the career field (54.5%). The largest response categories were recommendations to change management policies and improve work environment (primarily given by team members). This is somewhat exaggerated in that the authors subjectively broke comments on work environment and management into two categories to include individuals commenting on only one or the other.

In sum, the majority of the respondents do not feel 3901st SMES evaluations are an adequate appraisal of their performance. Respondents with more experience, and generally in supervisory positions, were consistently more critical of the evaluation process. Lack of experience and problems with training are the predominate reasons given for problems in personnel proficiency. An overwhelming majority of the respondents indicated hardware condition problems were a result of age and design inadequacies. The predominate recommendation given for improving training involves changing the Team Training Branch program by increasing its length and depth. The most significant recommendation for restructuring the career field was given by the more experienced respondents: specialize the career field.

V. Summary, Conclusions, and Recommendations

This research project examined whether or not the personnel proficiency of the missile facilities technician has decreased since civil engineering specialties were consolidated into one missile maintenance specialty. Additionally, the affect on the condition of the hardware they maintain was studied. This chapter will bring into focus the analyses of the 3901st SMES evaluation data and the AFIT survey responses, as well as the material in the literature review as they pertain to the problem identified in Chapter I. To accomplish this each research question will be considered individually.

Research Question One

Has the personnel proficiency of the facilities maintenance technician shown either improvement, deterioration, or remained the same since the consolidation occurred?

The first source of data for this question was the missile wing evaluation reports obtained from the 3901st SMES historical archives. All available reports were obtained, covering the period 1969 to 1983. Two areas from the reports were analyzed to arrive at a conclusion.

First, the wing pass rate was analyzed to determine if maintenance personnel proficiency, as a whole, had declined and to establish a base line for further analysis. The wing pass rate has not declined. Statistical tests show, with a 95% level of confidence, that the mean pass rate has remained unchanged since 1969. Therefore, it can be concluded that if facility maintenance performance is declining it is not part of a trend associated with all missile maintenance technicians.

The second area used to investigate personnel proficiency was the

percentage of unqualified grades (UQ) attributable to facility maintenance technicians of the total UQs awarded in each evaluation cycle. If wing pass rates remained constant (as they do) then any change in facility maintenance performance would be observable by a change in the percentage of UQs attributed to them. There is a statistically significant increase in this percentage over time. Therefore, it can be concluded that the personnel proficiency of facility maintenance technicians is declining. To relate it to the specialty consolidation, further testing was conducted to check for a statistical difference between the time periods 1969-1974 and 1975-1983. The test shows a difference does exist. For the period 1975 to 1983 facility maintenance technicians are accounting for a larger share of the total wing UQs awarded during 3901st SMES evaluations than for the earlier 1969 to 1974 period.

What this infers is, had facility maintenance technicians been maintaining a consistent level of proficiency, the overall pass rate for the wings should have increased over time. This inference is acceptable if it is assumed that overall performance will improve over time as corporate experience increases.

The second source of data used was the AFIT survey. The majority of respondents appear to have a healthy attitude toward their work: they are satisfied with their job and the quality of their work. There are, however, a significant minority that find their work is "so-so" to "very dull" and are "indifferent" or "hate" their job. Although research does not support an effect by work attitude on job performance, such large percentages of negative and ambivalent feelings toward the job is significant because it may indicate a morale problem.

Overall, the respondents feel the work they do is significant and important in relation to other maintenance jobs. There does not appear to be a lot of supervisory feedback provided to the respondents on job performance or quality of work. In addition to this is the finding that a large miniority do not agree that their shop supervisors are capable of providing technical assistance. These last two points are important in light of the research done on job characteristics models. According to the Hackman and Oldham model lack of feedback would zero out the Motivating Potential Score. (reference Figure 2) This would negatively effect the outcomes of work motivation, satisfaction, and effectiveness.

While it was found that technicians feel competent in their job overall, a large percentage tended to feel more competent in either power production or environmental control system tasks. Also, nearly one quarter of the respondents said they lack confidence in the performance of certain tasks because they perform them so infrequently. Taken in conjunction with the specialized use of technicians some supervisors were reporting it can be infered technicians are not having their training sufficiently reinforced to maintain their proficiency levels.

In general, supervisors feel the quality of technician work is at least average. However, the supervisors indicate personnel proficiency has declined since the consolidation of the career fields, and the majority do attribute it to the consolidation of the specialties. This tends to support the findings from the 3901st SMES data.

Although respondents did not indicate they have a personnel proficiency "problem" in the Likert scale questions, their responses to the open-ended questions indicate many do perceive a problem exists with

proficiency levels. They attribute these problems primarily to a lack of experience and training, with the next most frequently mentioned causes dealing with the size of the STS and the complex, diverse systems being worked on. While these responses appear to contradict each other they really do not because the Likert scale questions were directed at the individual technicians while the open-ended questions took a more global view of the entire career field. Therefore, the technicians are identifying a problem without taking responsibility for contributing to it.

An overwhelming majority of respondents indicate they would in some way like to change their training. This showed up both in the Likert scale questions and in the open-ended questions. Forty-two percent of the respondents felt their training had not prepared them for the tasks they are required to perform. This feeling is stronger in the area of environmental control training. The response does indicate, however, they feel better about troubleshooting procedures than checkout and repair work. In light of the material from the literature review this is very significant. Knowledge and skill (or lack thereof) is identified as a moderating variable in the Hackman and Oldham job characteristics model. Regardless of the quality and quantity of the core job characteristics, the work outcomes could still be significantly affected. These responses support the existance of qualitative overload which can effect job performance. In conjunction with the responses under personnel proficiency the theories on learning and training would tend to indicate insufficient training and inadequate reinforcement is occuring.

In conclusion, there is a problem with personnel proficiency

according to the 3901st SMES evaluation reports. The responses of the survey support this and provide some explanation for its existance. There is too much being taught in too little time.

Research Question Two

Has the hardware condition of the Minuteman weapon system shown either improvement, deterioration, or remained the same since the consolidation occurred?

An attempt was made to evaluate the impact of the consolidation on the environmental control system (ECS) and the power production system hardware. The evaluation of the ECS hardware using the 3901st SMES data was not possible because of missing data and changes in the reporting format. Evaluation of the power production hardware was made through the analysis of the diesel pass rates extracted from the 3901st SMES reports for the period 1969 to 1983.

The diesel pass rate reflects the number of diesels passing their test run during the 3901st SMES evaluation. It was chosen because facilities maintenance related technicians have always worked on them, the diesels are a significant aspect of the Minuteman system, and the condition of the diesels is closely monitored by HQ SAC personnel.

Statistical tests show the pass rate is declining over time. Tests of the before and after consolidation periods reveal the means after the consolidation are lower to a statistically significant degree. Due to the low confidence level a forecasting technique was used to determine if the decline could be expected to continue. Based on the previous pass rate data the decline is projected to continue. If a diesels ability to run on demand is an indication of its overall condition (as it is considered here) then the hardware condition is deteriorating.

The use of the diesel pass rates as a valid determinant of hardware condition should be accepted as valid. At this time diesel conditions are used as an indicator of hardware condition by HQ SAC personnel. However, the diesels and most other facilities related hardware are aging and there should be an expected decline in performance. How much this would affect their performance is not determinable with the available information. Interestingly, questions within the survey instrument pertaining to the primary problem with hardware condition reveals technicians regard aging to be the predominant problem, and not personnel proficiency.

As just mentioned, the overwhelming majority of survey respondents attribute general deterioration problems in the hardware to aging and not personnel proficiency. However, when supervisors were asked a similar question specifically identifying a particular system, they indicated the condition of the power production hardware had declined since the consolidation, disregarding the age factor. Areas other than age can also have an impact on hardware conditions. For the most part, they are the same ones that affect personnel proficiency: inadequate training, lack of reinforcement of training, inadequate feedback, and specialized use of technicians by supervisors.

Deficiencies in personnel proficiency do affect the quality of maintenance being performed on the hardware. The results of diesel pass rate analysis support this conclusion, as do the opinions of the survey respondents. However, this must be qualified with the statement that it is difficult, with the limited data available, to directly attribute a decline in hardware condition to the technicians. There are many intervening variables not considered in the analysis, such as weather,

decline in hardware condition to the technicians. There are many intervening variables not considered in the analysis, such as weather, age, and the integration of modifications.

Research Question Three

Has the consolidation of the specialities resulted in too much task complexity and/or task diversity?

Primary support for the answer to this research question comes from the literature review. Additional supporting information has come from telephone interviews.

The early literature on job design, specifically on quantitative overload, does not support the idea that the STS can be excessively large. Early research, as reported in Chapter II, focused on too little job variety and job scope resulting in unmotivating jobs and reduced worker job performance. This line of research, characterized by the Hackman and Oldham's Job Characteristics Model, resulted in job enrichment and enlargement programs. The consolidation of the specialized civil engineering fields into one missile maintenance field coincides well with this theory: broadening the scope and depth of a job. More recently, however, researchers looking at job characteristics have acknowledged it is possible to reach a maximum point in job scope, after which job performance will begin to decline. This later research does support the idea of an excessive STS size.

Other research, focusing on different aspects of the job (or role), began to consider this idea of overenrichment or overenlargement. Here researchers studied role ambiguity and role conflict (overload). Of these, role conflict (overload) reportedly does impact job performance, while role ambiguity acts on worker motivation and satisfaction.

Quantitative overload, dealing with an excessive number of tasks levied on the worker without regard for job complexity might be a possible cause of the personnel proficiency and hardware problems. Qualitative overload, resulting when the worker has inadequate skills or knowledge to complete the tasks, is another possible cause since the survey responses indicate technicians feel they have a deficit in training and experience. However, while these are possibilities none of the theories specified where the upper limits might be in order to allow evaluation of the STS.

The literature on learning and training theory addresses the question of maximum learning/training capacity only indirectly. The implication from the literature is that a person cannot learn too much if given enough time. This suggests, theoretically, that the STS cannot be too large so quantitative overload should not be occurring. However, according to the research, an individual can be expected to learn material too fast and with inadequate reinforcement to insure memory retention. Learning and retention can also be affected by the concurrent teaching of diverse subjects or the introduction of interferences to the training/learning process (e.g. additional duties, breaks between training courses). Hence, the STS may not be "too large", but it may be too diverse and complex for the methods currently used to train the technicians.

This is substantiated by the open-ended question survey responses and a telephone interview with CMSgt Charles Rogers, HQ SAC/LGBM. CMSgt Rogers, a major contributer to the writing of the current STS, agreed the STS was very large but qualified his statement by saying it was also one of the most detailed STSs in the Air Force. (Rogers, 1984) The

survey substantiates this by the low percentage of responses indicating STS size to be the primary contributor to personnel proficiency problems. Rather, the responses indicate technicians feel not enough training is occuring, it is not indepth enough, there is not enough hands-on training (the reinforcement), and it is not always being used after leaving the training program.

It is concluded that the current AFS 445X0G STS is not too large and the tasks required are not necessarily too diverse or complex if sufficient training and apprentice time are provided to the technician. The problem with the current STS lies with the time spent on training of these tasks, the depth taught, and the lack of continued reinforcement following initial training. Additionally, technicians are not provided sufficient and adequate feedback on their performance to make an accurate accessment of their personal proficiency. It is unrealistic to expect an individual, during the first term of enlistment, to become proficient and remain proficient in the diversity and number of tasks required by the current STS.

Other Findings

In addition to the findings directly supporting the research questions two other areas of significance evolved from the research and are presented for future consideration.

Responses to the questions on the accuracy of the 3901st SMES evaluations indicate there is a large percentage of individuals who feel the personnel proficiency evaluations are not adequate measures of day-to-day performance. The most frequent reason given is that evaluations are too infrequent and are not representative of actual routine

maintenance. Comments such as "it was a bad day" or "I didn't feel good" were frequently given as reasons for failing evaluations. It is also interesting to note that while a large percentage of respondents felt the 3901st SMES evaluations were not representative of their performance an even greater percentage felt that local Quality Control evaluations were far less representative of their performance. Another interesting note is that as the experience level of the respondent increases their opinion of the 3901st SMES decreases. This is highlighted by the fact that shop supervisors were the most negative sub-group of all the survey respondents.

Another area worth noting is the responses of the Periodic Maintenance Team (PMT) section respondents. This group had more negative responses on several of the attitude questions and opinions about supervisors. Also noteworthy, while not statistically significant, are the number of PMT members who question the value and utilization of their training. Many suggested training be targeted more directly at PMT related duties, as opposed to general facilities maintenance tasks. There were a number of comments in the openended questions where PMT technicians categorized themselves as "the clean-up crew" or the "site janitors." Additionally, they were the only ones to identify the poor attitude of other maintenance technicians as contributing to the poor condition of the hardware.

Recommendations

The missile facilities career field should be divided into two specialized areas: power production systems and environmental control systems. Training should be lengthened and made more indepth. This

recommendation considers the low experience level of the current work force and the assumption that the work force will continue to be primarily made up of young, first term enlistees. By splitting the career field you enable them to get the more indepth, longer training our research indicates is necessary for proficient work.

A second recommendation is to increase the time required for three skill level technicians to upgrade to the five skill level. As discussed earlier adequate apprentice time is also essential to the learning process, and will result in better task proficiency.

Third, the use of timely, accurate feedback should be emphasized at all levels of supervision. Feedback is critical to the accurate perception of performance and is necessary if performance is to improve. Specializing the career field will provide supervisors the opportunity to better understand their systems, and thus, give better feedback.

The last recommendation pertains to the generation of archival records. When the 3901st SMES evaluates a wing they should gather population demographic information for each base (e.g. rank, job position, years experience in the weapon system). This could be done through the use of a simple questionnaire input to computer answer sheets similar to the one used in this thesis. To do analysis comparing personnel over time would be easier if population demographic information were available. It would allow more indepth analysis of how demographic variables effect personnel proficiency.

Appendix A: 3901st SMES Evaluation Criteria

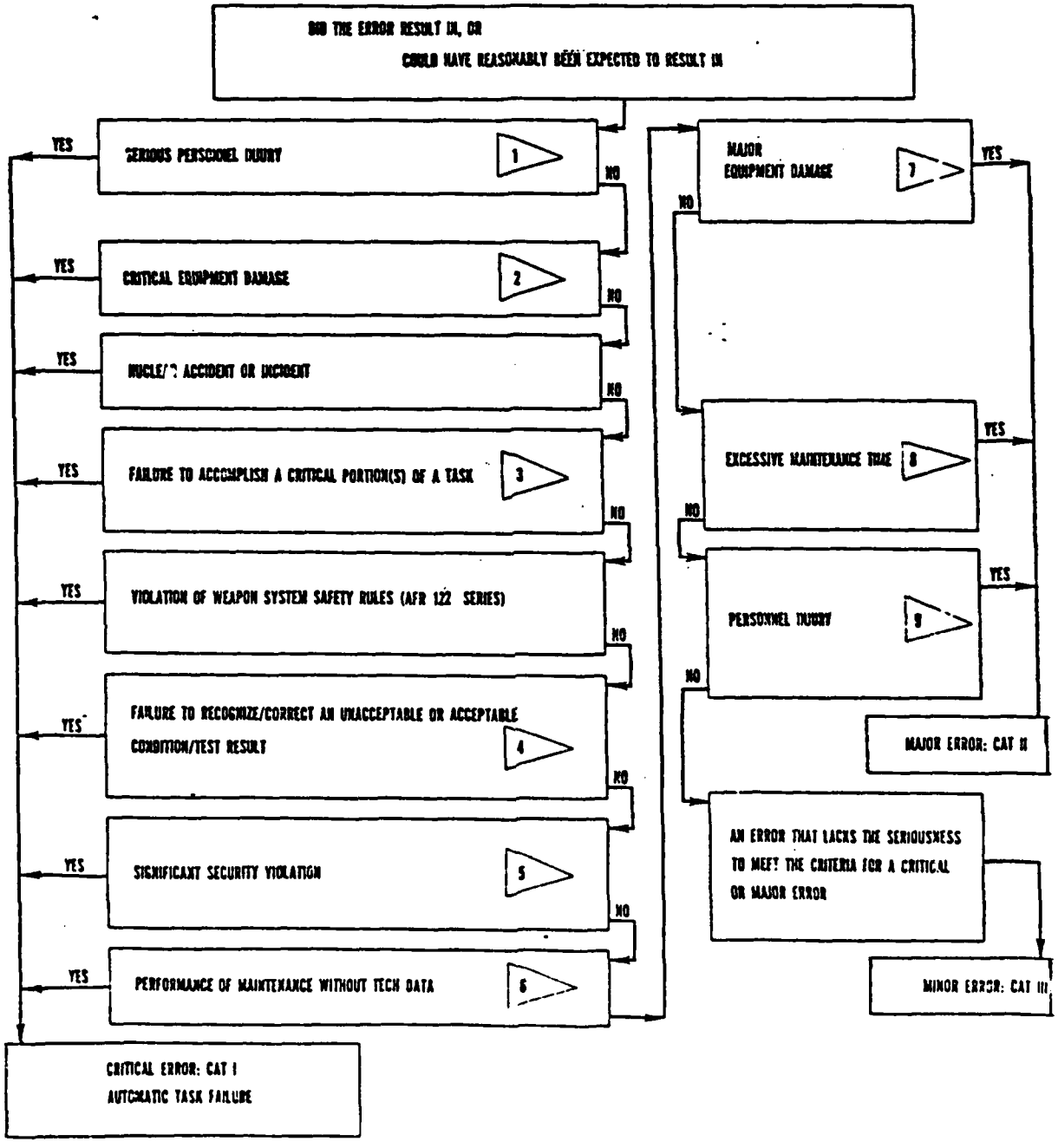


Figure 7 Task Error Decision Tree (USAF, 1981b)

RULE	A If the individual committed	B and	C and	D award a grade of
1	No error	N/A	performance of the overall task exceeded the acceptable level.	Highly Qualified (H)
2	No Cat I errors	No Cat II errors	The Cat III errors did not detract from overall outstanding job performance.	
3		One Cat II error	No Cat III errors, or the accumulation of Cat III errors did not result in unacceptable performance.	Qualified (Q)
4		No Cat II errors		
5	One or more Cat I errors	N/A	N/A	Unqualified (U)
6	No Cat I errors	Two Cat II errors	N/A	
7		One Cat II error	The accumulation of Cat III errors caused unacceptable performance.	
8		No Cat II errors	The excessive number of Cat III errors caused unacceptable performance.	

Figure 8. Personnel Proficiency Grade Criteria (USAF, 1981b)

Appendix B: AFIT Survey Instrument

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS STRATEGIC AIR COMMAND
OFFUTT AIR FORCE BASE, NEBRASKA 68113

REPLY TO ATTN OF: LGB

29 March 1984

SUBJECT: AFIT Survey of Missile Facilities Technicians (AFSC 445X0G)

TO:

1. The attached package contains a survey to be administered to Missile Facilities technicians assigned to your unit. This package is in support of an Air Force Institute of Technology (AFIT) research project being conducted by two missile maintenance officers, Captain Clark Popp and 1Lt Karen Selva. This project has been coordinated with and approved by this office. Survey control number is USAF SCN 84-12.

2. Completion of the survey is voluntary and should be done on a non-interference basis with workload requirements. We do however, solicit your support to make this project worthwhile.

3. Further instructions for the administration of this survey are contained in the package. We request that the Training Control Division be the point of contact for the control and administration of the survey. Captain Popp or Lt Selva will be making contact with your Training Control offices. In order to meet research deadlines, please forward the completed surveys no later than 27 April 1984.

4. The HQ SAC/LGBA point of contact is Lt Col Dennis McMahon, AV 271-2895.

ROBERT E. REED, JR., Lt Col, USAF
Deputy Director Missile Maintenance
DCS/Logistics

Peace . . . . is our Profession

GENERAL INFORMATION

A. Principal purposes. This survey is being conducted to collect information to be used in research aimed at illuminating and providing inputs to the solution of problems of interest to the Air Force and/or DOD.

c. Routine uses. The survey data will be converted to information for use in research of management related problems. Results of the research, based on the data provided, will be included in a written master's thesis and may also be included in published articles, reports, or texts. Distribution of the results of the research, based on the survey data, whether in written form or presented orally, will be unlimited.

d. Participation in this survey is entirely voluntary.

e. No adverse action of any kind may be taken against any individual who elects not to participate in any or all of this survey.

PARTICIPANT INFORMATION

The purpose of this questionnaire is to gather information on your feelings about your job, your own job performance, and the job training you received. This information is being collected in support of research on the Facilities Maintenance Technician career field (AFS 445X0G). It will help to determine perceptions about job performance and its effect on personnel proficiency and hardware conditions.

Please take time to consider each question. The success of this research project is dependent on you answering these questions as honestly, and openly as possible. The results of this questionnaire will be analyzed in terms of group averages by skill level. YOUR ANSWERS WILL BE KEPT STRICTLY ANONYMOUS.

Thank you for your cooperation in participating in this survey. If you have any questions, please contact one of us at the following address:

Capt Clark Popp
or
1Lt Karen Selva

Air Force Institute of Technology
School of Systems and Logistics
Wright-Patterson AFB, OH 45433
Telephone: (AUTOVON) 785-7212

KEYWORDS

The following are definitions of key words that recur throughout this questionnaire:

1. Power Production System: This term is used to include the diesel engine and subsystems, the power control center, the Minuteman Power Processer, and the power distribution systems (except where specifically broken out in Section III).

2. Environmental Control System: This term is used to include the brine chiller and its subsystems, the emergency air-conditioning subsystems, the launch tube heating system, and the associated electrical systems.

3. Power Distribution System: This term is used to include the Minuteman Power Processor, power control center, and associated systems.

4. Supervisor: An individual who is manned against a shop, branch, squadron supervisor slot, even though he might dispatch occasionally.

INSTRUCTIONS

To qualify to take this survey you must have a duty AFSC of 445X0G, and you must not be awaiting entry into the Team Training Branch program. This survey contains 70 questions divided into seven sections. All technicians, to include team chiefs, are asked to complete parts I through V. Supervisors are to complete parts I through III, and part VI. Individuals assigned to staff positions in other than supervisory positions should answer from the perspective of technicians. Part VII contains an open-ended questions section which all respondents are asked to complete. If for any question you do not find a response that fits your situation exactly, use the one closest to the way you feel.

Code the four digit number located on the front of this booklet in the spaces titled "1 2 3 4" in the upper right hand portion of the answer sheet.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. Make heavy black marks that fill in the space of the response you select.

2. Erase cleanly any responses you wish to change.

3. Make no stray markings of any kind on the response sheet.

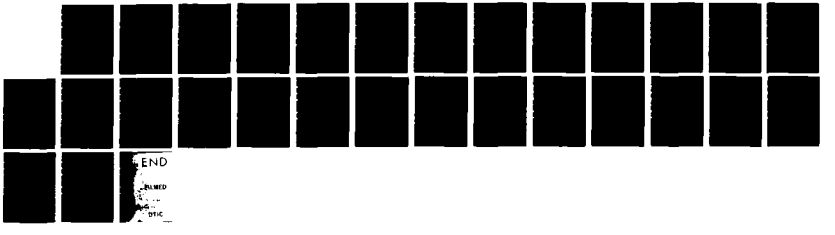
4. Do not staple, fold, or tear the response sheet.

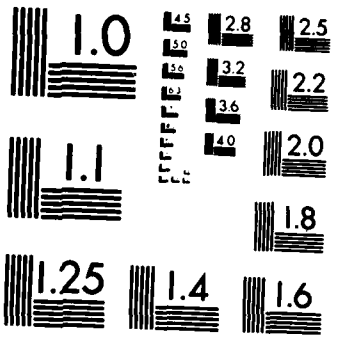
5. Insure you also mark your question booklet as you go along.

You have been provided with one answer sheet. Mark your answer booklet as you go along. DO NOT fill in your name on the answer sheet so that your responses will remain anonymous.

AD-A147 328 MINUTEMEN MISSILE FACILITIES MAINTENANCE TECHNICIAN (AFS 445X0G): ANALYSI..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. 2/2

UNCLASSIFIED S C POPP ET AL. SEP 84 AFIT/GLM/LSM/84S-54 F/G 5/9 NL





Section I. BACKGROUND INFORMATION

This section contains several items dealing with personal characteristics. This information will be used to describe the population of the study.

1. Your age is:
   1. less than 20 years
   2. 20 - 25 years
   3. 26 - 30 years
   4. 31 - 35 years
   5. 36 - 40 years
   6. 41 - 45 years
   7. more than 45 years

2. Your highest educational level obtained so far:
   1. non-high school graduate
   2. high school graduate, GED, or vocational school training
   3. some college work completed
   4. associates degree
   5. bachelors degree
   6. some graduate work
   7. master's degree

3. Your sex is:
   1. male
   2. female

4. Your current skill level is:
   1. 3-level, in Team Training Branch
   2. 3-level, working in the field
   3. 5-level
   4. 7-level

R 5. 9-level

5. Indicate any of the AFSC's listed below that you have held in your Air Force career.
   1. 541XX
   2. 542XX
   3. 543XX
   4. 545XX
   5. 552XX
   6. not applicable

6. If you held one of the above 54XXX or 552XX AFSCs how long did you have it before you cross-trained to the AFS 445X0G career field?
   1. less than 1 year
   2. 1 - 3 years
   3. 4 - 5 years
   4. 6 - 10 years
   5. more than 10 years
   6. not applicable

7. The total time you have worked in the Minuteman system since originally entering the Team Training Branch is:
   1. less than 1 year
   2. 1 year but less than 2 years
   3. 2 years but less than 4 years
   4. 4 years but less than 8 years
   5. 8 years but less than 12 years
   6. 12 years or more

8. Your rank is:
   1. Amn or A1C
   2. SrA
   3. Sgt
   4. SSgt
   5. TSgt
   6. MSgt
   7. SMSgt or CMSgt

9. You are currently serving as a:
   1. team member
   2. team chief
   3. shop supervisor (the majority of the time)
   4. branch or squadron supervisor
   5. staff member (eg. Quality Control, Maintenance Control, etc)

10. Indicate the functional area to which you are presently assigned:
   1. Facilities Maintenance Team Branch
   2. Periodic Maintenance Team Branch
   3. Training Control Division
   4. Quality Control Division
   5. Maintenance Control Division
   6. Other

11. To which base are you assigned:
   1. Ellsworth AFB
   2. F.E. Warren AFB
   3. Grand Forks AFB
   4. Malmstrom AFB
   5. Minot AFB
   6. Whiteman AFB
   7. Vandenberg AFB

Section II. WORK ATTITUDES

This section of the questionnaire contains a number of statements that relate to feelings you have about your job.

12. How do you find your job
    1. very dull
    2. dull
    3. somewhat dull
    4. so-so
    5. somewhat interesting
    6. interesting
    7. very interesting

13. How do you feel about your job?
    1. terrible
    2. unhappy
    3. mostly dissatisfied
    4. mixed
    5. mostly satisfied
    6. pleased
    7. delighted

14. How much do you use your AFS 445X0G training in your present job?
    1. not at all
    2. very little
    3. little
    4. fair amount
    5. quite a bit
    6. a lot
    7. almost all the time

15. In general, at the end of a maintenance dispatch I often feel I have accomplished something.
    1. strongly disagree
    2. disagree
    3. slightly disagree
    4. neither disagree nor agree
    5. slightly agree
    6. agree
    7. strongly agree

16. How satisfied are you with the sense of accomplishment you gain from your work?
    1. extremely dissatisfied
    2. dissatisfied
    3. slightly dissatisfied
    4. neither satisfied nor dissatisfied
    5. slightly satisfied
    6. satisfied
    7. extremely satisfied

*Use the scale below to answer the remaining questions on this page.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

17. The job I do is very significant and important in relationship to all other maintenance jobs. 1 2 3 4 5 6 7

18. In general, my shop and branch supervisors care about the quality of the work I do. 1 2 3 4 5 6 7

19. In general, my shop and branch supervisors encourage me to constantly improve the quality of my work. 1 2 3 4 5 6 7

20. In general, my shop and branch supervisors provide adequate support for me to accomplish my job. (eg. solving dispatch problems, supporting my decisions, etc) 1 2 3 4 5 6 7

21. In general, I am happy with the quality of supervision my supervisors provide. 1 2 3 4 5 6 7

Section III. RELATIVE TIME SPENT ON MAINTENANCE TASKS

Using the scale below indicate the percentage of time you spend on maintenance dispatches for the indicated problems. Percentages indicate the time you spend actually performing maintenance (not administrative, training, travel, etc).

FOR SUPERVISORS: Please indicate the percentage of time for all 445XOGs under your supervision.

1. 0 - 10% (seldom or never do the task)
2. 11 - 20% (occasionally do the task)
3. 21 - 30% (sometimes do the task)
4. 31 - 40% (frequently do the task)
5. 41 - 50% (usually do the task)
6. 51 - 75% (often do the task)
7. over 75% (do the task almost all the time)

22. The percentage of time I spend performing troubleshooting of the power production system is: 1 2 3 4 5 6 7

23. The percentage of time I spend performing checkout and/or repair on the power production system is: 1 2 3 4 5 6 7

24. The percentage of time I spend performing troubleshooting of the environmental control system is: 1 2 3 4 5 6 7

25. The percentage of time I spend performing checkout and/or repair on the environmental control system is: 1 2 3 4 5 6 7

26. The percentage of time I spend performing troubleshooting of the power distribution system is: 1 2 3 4 5 6 7

27. The percentage of time I spend performing checkout and/or repair on the power distribution system is: 1 2 3 4 5 6 7

28. The percentage of time I spend doing other maintenance tasks, other than those mentioned above, is: 1 2 3 4 5 6 7

Section IV. PERSONNEL PROFICIENCY PERCEPTIONS

This section of the questionnaire contains a number of statements that relate to feelings and perceptions you have about your own maintenance performance on the job. Use the following rating scale to indicate the extent to which you agree or disagree with the statements shown below.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

29. In general, I feel competent in the performance of my job. 1 2 3 4 5 6 7

30. In general, I feel more competent in the performance of power production tasks than environmental control tasks. 1 2 3 4 5 6 7

R31. In general, I feel more competent in the performance of environmental control tasks than power production tasks. 1 2 3 4 5 6 7

32. Evaluations performed by Quality Control accurately measure how well I do my job. 1 2 3 4 5 6 7

33. Evaluations performed by the 3901st SMES accurately measure how well I do my job. 1 2 3 4 5 6 7

34. I feel good about the quality of the work I perform. 1 2 3 4 5 6 7

35. When I am required to perform power production tasks, the work often must be reaccomplished because I did not understand the system sufficiently to properly identify the problem and/or repair it. 1 2 3 4 5 6 7

36. When I am required to perform environmental control system tasks, the work often must be reaccomplished because I did not understand the system sufficiently to properly identify the problem and/or repair it. 1 2 3 4 5 6 7

37. When I am required to perform certain power production system tasks, although I was trained, I lack confidence because I perform the tasks so infrequently. 1 2 3 4 5 6 7

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

38. When I am required to perform certain environmental control system tasks, although I was trained, I lack confidence because I perform the tasks so infrequently. 1 2 3 4 5 6 7

39. In general, my shop supervisor is capable of providing technical assistance in power production tasks. 1 2 3 4 5 6 7

40. In general, my shop supervisor is capable of providing technical assistance in environmental control systems. 1 2 3 4 5 6 7

* Use the scale below to answer the next four questions in this section.

1. Never
2. Almost never
3. Seldom
4. Sometimes
5. Usually
6. Almost always
7. Always

41. When I perform troubleshooting, checkout and/or repair on the power production system I require outside assistance. 1 2 3 4 5 6 7

42. When I perform troubleshooting, checkout and/or repair on the environmental control system I require outside assistance. 1 2 3 4 5 6 7

43. In general, my supervisor provides feedback on my job performance. 1 2 3 4 5 6 7

Section V. Training Perceptions

This section of the questionnaire is similar to the preceding one except the questions pertain to the overall training you have received. Answer each question using the scale below and selecting the answer that best describes how you feel.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

44. In general, my training has prepared me to do all the tasks I am required to do.	1 2 3 4 5 6 7
45. My training on the environmental control system (ECS) has prepared me to do all the ECS tasks required of me.	1 2 3 4 5 6 7
46. My training in troubleshooting the environmental control system has given me a good understanding of how to find ECS related problems.	1 2 3 4 5 6 7
47. My training on the power production system has prepared me to do all the power production tasks required of me.	1 2 3 4 5 6 7
48. My training in troubleshooting the power production system has given me a good understanding of how to find power production related problems.	1 2 3 4 5 6 7
49. My training was too long and covered too many areas for me to retain all I was taught.	1 2 3 4 5 6 7
50. My training would have been more beneficial if I had only been required to learn either the power production system or the environmental control system, but not both.	1 2 3 4 5 6 7
51. I feel the material I learned in my Career Development Course (CDC) has helped improve my maintenance proficiency.	1 2 3 4 5 6 7
52. I feel that upgrading technicians to the 5 level following completion of their CDC gives them enough time to acquire the knowledge and skill expected of a 5 level.	1 2 3 4 5 6 7
53. I would not change anything about my training.	1 2 3 4 5 6 7

* IF YOU DO NOT HOLD A SUPERVISOR POSITION THE MAJORITY OF THE TIME THEN YOU MAY SKIP THE NEXT SECTION, PART VI, AND PROCEED TO PART VII.

Part VI. Supervisor Perceptions

Use the following scale to answer questions 54 and 55.

1. very poor quality
2. poor quality
3. below average quality
4. average
5. above average quality
6. high quality
7. very high quality

54. The maintenance performed by the technicians I supervise on the power production system is of ... 1 2 3 4 5 6 7

55. The maintenance performed by the technicians I supervise on the environmental control system is of ... 1 2 3 4 5 6 7

* Use the scale below to answer the following questions.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree

56. The technicians I know who were trained prior to the creation of the 445X0G career field are more knowledgeable than the technicians today. 1 2 3 4 5 6 7

57. I feel that I was more knowledgeable as a technician than the people I supervise today, with the same number of years experience. 1 2 3 4 5 6 7

58. I have a group of technicians that I consider to be more knowledgeable in power production, and as a result, I dispatch them to solve the power production system related problems most of the time. 1 2 3 4 5 6 7

59. I have a group of technicians that I consider to be more knowledgeable in environmental control, and as a result, I dispatch them to solve the environmental control system related problems most of the time. 1 2 3 4 5 6 7

60. I feel I have adequate task coverage in the power production system tasks. 1 2 3 4 5 6 7

61. I feel I have adequate task coverage in the environmental control system tasks. 1 2 3 4 5 6 7

* Use the scale below for the next three questions.

1. strongly disagree
2. disagree
3. slightly disagree
4. neither disagree nor agree
5. slightly agree
6. agree
7. strongly agree
8. do not know

62. Personnel proficiency has declined since the AFSC consolidation occurred. 1 2 3 4 5 6 7

63. The condition of the power production hardware maintained by Facility Maintenance Technicians (AFS 445X0G) has declined since the AFSC consolidation occured, disregarding the age of the weapon system. 1 2 3 4 5 6 7

64. The condition of the environmental control hardware maintained by Facility Maintenance Technicians (AFS 445X0G) has declined since the AFSC consolidation occured, disregarding the age of the weapon system. 1 2 3 4 5 6 7

* Use the scale indicated for this last question.

65. I feel that consolidation of the career fields has had the following effect on technician proficiency levels.

1. greatly decreased it
2. decreased it
3. slightly decreased it
4. had no effect
5. slightly increased it
6. increased it
7. greatly increased it

Section VII. IN YOUR OPINION.

This section is your opportunity to bring forth any suggestions or criticisms you might have. Answer in the space provided beneath the question. If you do not have enough room in the space then use the separate sheet provided, and be sure to indicate the question number you are responding to.

66. Do you think the 3901st Strategic Missile Evaluation Squadron evaluations are an adequate evaluation of your personal job proficiency? Please state why or why not.

67. If you perceive that a problem exists with personnel proficiency levels, what would you consider the main reason to be? (re: STS size training, task diversity, lack of experience, too short an apprent' time)

68. If you perceive that a problem exists with the condition of the hardware, what would you consider the main reason to be? (re: an aging system, 445X0G personnel inabilities, management practices)

69. How would you improve your training program to increase the overall level of personnel proficiency?

70. If you could change the way your career field is structured or managed what would you want to see done? (AFS 445X0G)

Appendix C: SPSS Program For Survey Analysis

```
RUN NAME        SURVEY RESULTS
DATA LIST       FIXED(1)/1 ID# 1-4 Q1 5 Q2 6 Q3 7 Q4 8 Q5 9 Q6 10
                Q7 11 Q8 12  Q9 13 Q10 14 Q11 15 Q12 16 Q13 17
                Q14 18 Q15 19 Q16 20 Q17 21 Q18 22 Q19 23 Q20 24
                Q21 25 Q22 26 Q23 27 Q24 28 Q25 29 Q26 30 Q27 31
                Q28 32 Q29 33 Q30 34 Q31 35 Q32 36 Q33 37 Q34 38
                Q35 39 Q36 40 Q37 41 Q38 42 Q39 43 Q40 44 Q41 45
                Q42 46 Q43 47 Q44 48 Q45 49 Q46 50 Q47 51 Q48 52
                Q49 53 Q50 54 Q51 55 Q52 56 Q53 57 Q54 58 Q55 59
                Q56 60 Q57 61 Q58 62 Q59 63 Q60 64 Q61 65 Q62 66
                Q63 67 Q64 68 Q65 69 Q66A 70 Q66B 71 Q67A 72 Q67B 73
                Q68A 74 Q68B 75 Q69A 76 Q69B 77 Q70A 78 Q70B 79
VAR LABELS      ID#, NUMBER ASSIGNED TO ANSWER SHEET/
                Q1, AGE/
                Q2, EDUCATION LEVEL/
                Q3, SEX/
                Q4, SKILL LEVEL/
                Q5, PREVIOUS AFSC/
                Q6, TIME IN PREVIOUS AFSC/
                Q7, TOTAL TIME IN MINUTEMAN/
                Q8, RANK/
                Q9, POSITION/
                Q10, ASSIGNED AREA/
                Q11, BASE OF ASSIGNMENT/
                Q12, JOB ATTITUDE/
                Q13, JOB ATTITUDE/
                Q14, TRAINING USE/
                Q15, JOB ACCOMPLISHMENT/
                Q16, SATISFACTION WITH ACCOMPLISHMENT/
                Q17, JOB SIGNIFICANCE/
                Q18, SUPER CONCERN FOR QUALITY/
                Q19, SUPER ENCOURAGE QUALITY/
                Q20, SUPER SUPPORT/
                Q21, QUALITY OF SUPER/
                Q22, TS PPRO/
                Q23, CO & REPAIR OF PPRO/
                Q24, TS ECS/
                Q25, CO &REPAIR OF ECS/
                Q26, TS POWER DIST/
                Q27, CO & REPAIR OF POWER DIST/
                Q28, OTHER MAINT TASKS/
                Q29, COMPETANCY/
                Q30, COMPETENT IN PPRO/
                Q31, COMPETENT IN ECS/
                Q32, QC MEASURE PROF/
                Q33, SMES MEASURE OF PROF/
                Q34, QUALITY OF WORK/
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                Q35, REACC OF PPRO WORK/
                Q36, REACC OF ECS WORK/
                Q37, INFREQ PPRO TASKS/
                Q38, INFREQ ECS TASKS/
                Q39, SUPER QUAL IN PPRO TASKS/
                Q40, SUPER QUAL IN ECS TASKS/
                Q41, PPRO OUTSIDE ASSIST/
                Q42, ECS OUTSIDE ASSIST/
                Q43, SUPER FEEDBACK/
                Q44, TRAINING PREPARATION/
                Q45, ECS TRAIN PREP/
                Q46, TS TRAIN IN ECS/
                Q47, PPRO TRAIN PREP/
                Q48, TS TRAIN IN PPRO/
                Q49, TRAIN TOO LONG AND TOO BROAD/
                Q50, TRAIN EITHER PWR OR ECS/
                Q51, CDC CONTRIBUTE TO PROF/
                Q52, FIVE LEVEL AFTER CDC/
                Q53, NO CHANGE TO TRAIN/
                Q54, PPRO MAINT QUALITY SUPER/
                Q55, ECS MAINT QUALITY SUPER/
                Q56, KNOW BEFORE OR AFTER 445/
                Q57, SUPER MORE KNOW/
                Q58, SUPER USE PPRO GROUP/
                Q59, SUPER USE ECS GROUP/
                Q60, SUPER COVERAGE IN PPRO/
                Q61, SUPER COVERAGE IN ECS/
                Q62, PP DECLINED/
                Q63, PPRO HARD DECLINED/
                Q64, ECS HARD DECLINED/
                Q65, EFFECT OF CONSOLIDATION/
                Q66, OE SMES/
                Q67, OE PERS PROF/
                Q68, OE HARDWARE COND/
                Q69, OE TRAINING/
                Q70, OE CHANGE CAREER FIELD/
VALUE LABELS    Q1 (0) <20 (1) 20-25 (2) 26-30 (3) 31-35 (4) 36-40
                (5) 41-45 (6) >45/
                Q2 (0) NO H.S. (1) H.S. GRAD (2) SOME COLLEGE
                (3) ASSOC DEG (4) BACH (5) GRAD SCHOOL (6) MAST/
                Q3 (0) MALE (1) FEMALE/
                Q4 (0) 3LEVL TTB (1) 3LVL FIELD (2) 5LVL (3) 7LVL
                (4) 9LVL/
                Q5 (0) 541XXX (1) 542XX (2) 543XX (3) 545XXX
                (4) 552XXX (5) N.A./
                Q6 (0) <1 YR (1) 1 TO 3 YRS (2) 4 TO 5 YRS
                (3) 6 TO 10 YRS (4) >10 YRS (5) N.A./
                Q7 (0) <1 YR (1) 1 < 2 YR (2) 2 < 4 YRS (3) 4 < 8
                YRS (4) 8 < 12 YRS (5) 12 OR MORE/
                Q8 (0) A1C (1) SRA (2) SGT (3) SSGT (4) TSGT
                (5) MSGT (6) SMSGT OR CMSGT/
                Q9 (0) TEAM MEMBER (1) TEAM CHIEF
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                (2) SHOP SUPER (3) BR OR SQ SUPER (4) STAFF/
                Q10 (0) FMT (1) PMT (2) TRAINING (3) QC
                (4) MAINT CONT (5) OTHER/
                Q11 (0) ELLSWORTH (1) F.E. WARREN (2) GRAND FORKS
                (3) MALMSTROM (4) MINOT (5) WHITEMAN (6)
                VANDENBERG/
                Q66 (0) NOT EVAL (1) NO (2) YES (3) NO NOTICE/
                Q67 (0) EXPERIENCE (1) TRAINING (2) COMP-TASK DIV (3) STS SIZE
                (4) ATTITUDES (5) APPRENT TIME (6) OTHERS (7) NO PROB/
                Q68 (0) AGE (1) MANAGE (2) INEXPER (3) POOR HARD (4) NO PROB
                (5) TECH ATTITUDE (6) OTHERS/
                Q69 (0) LENGTH TRAIN (1) ECS OR PP (2) MORE INDEPTH (3) HANDS ON
                (4) TTB (5) OTHER (6) NO CHANGE/
                Q70 (0) MGT (1) NO CHG (2) SPECIALIZE (3) TRAIN (4) CROSS TRAIN
                (5) WK ENVIRON (6) MANNING (7) OTHERS/
RECODE          Q1(BLANK=9)/Q2(BLANK=9)/Q3(BLANK=9)/Q4(BLANK=9)/
                Q5(BLANK=9)/Q6(BLANK=9)/Q7(BLANK=9)/Q8(BLANK=9)/
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                Q12(BLANK=9)/Q13(BLANK=9)/Q14(BLANK=9)/
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                Q18(BLANK=9)/Q19(BLANK=9)/Q20(BLANK=9)/
                Q21(BLANK=9)/Q22(BLANK=9)/Q23(BLANK=9)/
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                Q27(BLANK=9)/Q28(BLANK=9)/Q29(BLANK=9)/
                Q30(BLANK=9)/Q31(BLANK=9)/Q32(BLANK=9)/
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                Q63(BLANK=9)/Q64(BLANK=9)/Q65(BLANK=9)/
MISSING VALUES  Q1(9)/Q2(9)/Q3(9)/Q4(9)/Q5(9)/Q6(9)/
                Q7(9)/Q8(9)/Q9(9)/Q10(9)/Q11(9)/Q12(9)/Q13(9)/
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READ INPUT DATA
END INPUT DATA
FINISH
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Appendix D: AFIT Survey Data Base For SPSS Program

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VITA

Captain Stephen C. (Clark) Popp was born in Johnstown, Pennsylvania on 24 November 1951. He graduated from Valley High School in Louisville Kentucky in 1969. In 1974 he graduated from the University of Kentucky with a Bachelor of Arts degree in Secondary Education and recieved a commission in the USAF through the ROTC program. His first assignment was to 381st Strategic Missile Wing (SAC) McConnell AFB, Kansas, as a Titan II Missile Maintenance Officer. Captain Popp served as a site maintenance officer, wing job control officer and OIC of the Consolidated Maintenance Team section. While stationed in Kansas he earned a Master of Education degree in Guidance and Counseling at Wichita State University graduating in 1979. Captain Popp was then assigned to Headquarters Strategic Air Command, Directorate of Missile Maintenance, DCS Logistics, as a Titan II Logistics Manager. While at HQ SAC he also served as the Titan II Training Program Manager. He entered the School of Systems and Logistics, Air Force Institute of Technology, in June 1983.

Permanent address: 8901 Mountain Brooke Drive
Louisville, Kentucky 40272

VITA

Captain Karen L. Selva was born on 27 June 1957 in San Francisco, California. She graduated from high school in Hayward, California in 1975 and attended the United States Air Force Academy from which she received a Bachelor of Science degree in 1980. Upon graduation she was assigned to the 321st Strategic Missile Wing, Grand Forks AFB North Dakota, as a Minuteman Missile Maintenance Officer. In 1982 she was appointed chief, Materiel Control Branch for the Wing Maintenance Deputate. She continued to serve in this capacity until entering the School of Systems and Logistics, Air Force Institute of Technology in June of 1983.

Permanent address: 1352 Fry Lane
Hayward, California 94545

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Thesis Chairman: Russel F. Lloyd, Lieutenant Colonel, USAF

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Since the consolidation of several civil engineering career fields into one generalized Minuteman facility maintenance specialty there has been debate over whether it resulted in more effective maintenance and better trained technicians, or whether personnel proficiency and hardware conditions have deteriorated. To study this question historical data from 3901st Strategic Missile Evaluation Squadron reports was analyzed in terms of personnel proficiency ratings and diesel pass rates. Additionally, a survey of the technicians was conducted to determine their perceptions of their performance. Results indicate personnel proficiency and diesel pass rates have declined since the consolidation of the specialties, and corrective action will be complicated by technicians perceptions of their adequate job proficiency. Recommendations include dividing the technicians into specialized maintenance areas, modifying training programs to accomadate this specialization, increasing the time required for upgrade to the five skill level, emphasizing adequate feedback at all levels of supervision, and improving the information maintained in evaluation archival records.